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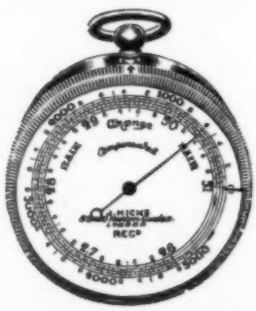

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ECONOMIC POLICY AND MAN-POWER

THE need for a comprehensive and coherent policy covering the whole of the economic field has repeatedly been pressed upon the Government, with little apparent effect. One cause of the misgivings often expressed lies in the upward trend of prices, encouraged by the disparity between the purchasing power poured into the market by Government expenditure and the fall in supplies inseparable from war conditions, resulting in some commodities being beyond the reach of families not engaged in any munitions industry, apart from the many whose incomes have fallen off or who have become unemployed. The Purchase Tax itself has given a further impetus to raising the cost of living, and the increase in railway charges has given a sharp reminder of dangers attending the absence of any consistent policy for the control of wages, costs, and prices. Moreover, there has been no indication of the methods by which the Government proposes to prevent the dislocation and anomalies which are bound to attend the increasing deflection of non-essential industries to war purposes if businesses and individuals affected are left to adjust themselves to the new conditions without guidance and assistance. We have no evidence of any plan for collective action by industries to enable them to switch into direct war work the maximum of man-power and equipment with the minimum of friction and economic waste, or of any wide extension of rationing and price-fixing to ensure fair distribution of the reduced quantities of goods available.

The greatest single cause of misgiving is the persistence of unemployment on a relatively large scale. Most economists agree that these figures clearly indicate that the war machine is failing to absorb labour as quickly as the civilian industries are releasing it. Misgivings publicly expressed by such authorities as Prof. Pigou cannot be lightly dismissed, and while leadership admittedly can achieve better results than dictation, such leadership must possess a definite aim and a clear understanding of the means of attaining it.

It is the absence of the prompt and firm use of such powers to remove difficulties before they become really serious which indicates the lack of an adequate central economic plan. Mr. Bevin's general references to an enormous call-up for the Services and for munitions industries between now and next June, coupled with the absence of measures to facilitate even the transfer to munitions work or the armed Forces of the 75,000–100,000 workers which Mr. Greenwood has estimated would be liberated by curtailment of home production between now and May, are indeed somewhat disturbing. The balance between industrial workers and combatants is delicate, and to be determined with the fullest circumspection. The war will be won by mechanisms, not by vast masses of men, and our limited population cannot multiply combatants and the mechanized weapons they require at the same time.

Apart from this difficult question, there is the balance between the distribution of skilled labour not only in the munitions industry so as to ensure the maximum use of all available labour, skilled and unskilled, but also with reference to the demands of the armed Forces, shipbuilding, and the like, for technicians.

Not merely man-power, but the whole of our economic resources, whether production of munitions or foodstuffs, import and export policy, rationing of food or other essential commodities, and restrictions of manufacture and on means

of transport or shipping, must fall into the proper place as part of a single economic plan intimately related to the strategy and plan of campaign of the Fighting Services. Above all, this plan must be conceived in an offensive and not purely a defensive spirit, and by minds alert to the creative possibilities of new ideas and new measures.

The recent Cabinet reorganization announced by the Government may be regarded as in some measure a reply to such criticisms. It is, however, difficult at first sight to believe that the re-casting of the machinery thus announced will effect much more co-ordination or eliminate the dangerous amount of free fighting between departments. Mr. Churchill has himself assumed responsibility for ensuring that the work of the Production and Import Executives corresponds to the general policy of the War Cabinet, but we are still without any minister, backed by an adequate selected general staff, to handle the whole field of economic affairs.

The new Import and Production Executive Committees which replace the previous councils, although of much the same departmental composition, will possess executive powers, and their work, as well as that of the three existing committees on civil defence, home policy, and food policy, will be concerted and directed by a committee on which the chairmen of all these bodies sit, under the chairmanship of the Lord President of the Council. This committee will advise the Cabinet generally on the movement of business in the executive committees and on special questions remitted to it. It will also deal with the general issues of economic policy formerly considered by the Economic Policy Committee.

The official announcement expresses the hope that these arrangements will bring the very complicated affairs of government in war-time into a simpler and more closely knit structure, with a reduction in the number of subsidiary committees and the promotion of rapid and decisive action, while preserving the constitutional responsibilities of ministers to the Crown and Parliament. Such a system of committees, however, can scarcely be viewed without misgivings by students of scientific management. *Prima facie*, it appears to disregard the fundamental principles of organization and the span of command, and to place upon the committee system a burden which that useful aid to management should not be expected to shoulder.

Mr. Churchill devoted some part of his speech in the House of Commons on January 22 to a defence and explanation of these arrangements. In spite of a spirited defence of the committee system, the Prime Minister scarcely met the real point of the criticism, and uneasiness as to the persistence of departmentalism was not dispelled, willing as all may be to judge the system by its results. It is, after all, the evidence as to the lack of a general and coherent plan that has stimulated criticism of the machinery of government in the first instance, and the report of Lord Haldane's Committee on the Machinery of Government may yet supply pertinent reading after more than twenty years' neglect.

Although dissatisfaction with the Government's labour and economic policy is freely expressed, it should not be imagined that shortcomings are only to be found on the Government side. There is little enough evidence in Mr. John Price's "Organized Labour in the War", published last autumn in the Penguin series, of a wider vision or sense of unity.

What the Government must recognize is that public opinion fully realizes that our economic and man-power resources, great as they are, are definitely limited, and we can no longer afford to tolerate limitation of output, reluctance to transfer to urgent work because of inconvenient travelling, or opposition to the introduction of trainees. The greatest impatience, indeed, with Government policy arises out of what is felt to be the excessive dependence of ministers upon appeals to the public in matters where they have, at their own request, been given power to take whatever action may be necessary. We can carry our servience to the voluntary principle to a point at which the very cause of freedom is endangered.

Ready as the public may be to accept the use of the compulsory powers with which the Minister of Labour and National Service, for example, has been endowed, it does not follow that the first steps need be taken in his own immediate domain. There must undoubtedly be swifter executive action in dealing with industrial treachery, but the mobility of the national labour force may well be increased indirectly by such means as compulsory billeting for transferred workers, or adequate attention to welfare work. These, with an overhaul of the present priorities system and the careful handling of the extended training programmes and of the effective utilization of the firms engaged in the non-essential industries with their resources in man-power, capital equipment, and business organization, should go far to keep compulsion to

a minimum, provided it is clear that the Government will not hesitate to use its powers if necessary.

The industrial registration plan outlined by Mr. Bevin at the beginning of the debate on man-power and production in the House of Commons on January 21, by which it is hoped that all reserves of labour will be mobilized for war work, promises the development of a more scientific policy, although critics in the debate pressed for stronger action. None the less, Mr. Bevin could point to certain measures which had been or were being taken to improve the immediate situation, as in repair and turnover of shipping, and his subsequent statement after his conference with the General Council of the Trades Union Congress and the Council of the British Employers' Confederation should go some way to dispel fears that the Ministry will be lacking in firmness where voluntary measures may fail or prove inadequate.

The paper on "Some Problems of War-time Labour Management", which Dr. K. G. Fenelon gave before the Royal Society of Arts last autumn, illustrates how important a contribution to the conservation and efficient utilization of our man-power resources can be made by wise management. Here, as in the new machinery announced by the Government, it is largely a question of personalities. Men and not machinery will decide whether or not the new War Executive is capable of winning the War.

Co-ordination is, of course, at bottom, the ordinary work of administration. Co-ordination of plans and performance is a condition of the day-to-day working and management of any business or industrial undertaking, and when difficulties arise it is more often that lack of a policy and a programme are the root cause, rather than lack of co-ordination.

What is required now is action, not merely plans, and if Mr. Churchill's reshuffle leads to sovereignty and authority in economic policy and not mere machinery, it may open the way to that gathering momentum in production and ruthless common sense in trade and distribution on which alone victory can be based. Effective action must, none the less, be dictated by a coherent plan taking account of all our resources of man-power and materials, eliminating all sources of waste, and determining the size of our Army, not independently, but in relation to the resources available to meet the needs of the Navy, shipbuilding, and the merchant navy, the requirements of the Air Force, the various branches of Civil Defence, and the demands of food production and transport.

THE WORLD IN UNITY AND STRUGGLE

Dialectics of Nature

By Frederick Engels. Translated and edited by Clemens Dutt. Pp. xvi+383. (London : Lawrence and Wishart, Ltd., 1940.) 15*s*. net.

FREDERICK ENGELS died in 1895, one year before Röntgen's discovery of X-rays and the enormous flowering of physical and chemical knowledge that followed from it. Science to-day is very different from what it was in his time, and the appearance for the first time in English of his main theoretical work, "Dialectics of Nature", may seem a matter only of historical curiosity. We might wonder, indeed, why at this late date it is worth bringing to light at all instead of relegating it to the forgetfulness that has fallen on the theoretical works of even the greatest of the Victorians.

The question can only be answered by picking up the book. "Dialectics of Nature" has a different quality; it does not belong to the normal stream of Victorian thought. Had it appeared at the time it was written, a great majority of scientific workers would not have read it, and those who did would have considered it to be ridiculous philosophic nonsense. That was because Engels did not consider science in any narrow framework; he saw it always as part of a general movement of human and universal history. He had a comprehensiveness of view that appeals to us much more now than it did to his contemporaries. Two trends, one inside science and one in the world of human affairs, have brought us nearer to appreciation of Engels' meaning. The progress of scientific ideas: relativity, the quantum theory, the development of biochemistry and genetics, have added immensely to our understanding of Nature, but they have provided not only knowledge but also deeper problems and difficulties—difficulties that were not visible in the classical scientific world picture which rested on Newtonian mechanics and Darwinian evolution. Engels' main concern is just with those fundamental difficulties; on the relation of matter and movement, on the nature

of cause and effect, on the irreversible historic aspects linking the inorganic and the organic worlds.

But science does not proceed in a vacuum. It is not only the world of thought but the world of action that has been transformed and has shown both the enormous growth of human power and the problems and struggles which the social utilization of that power has engendered. Physically as well as intellectually, we are in a far less secure world than our grandparents, and it is in this world of struggle that the ideas of Engels, and of his great companion in arms, Marx, have found their most convincing expression. To the Victorian mind freedom broadened down from precedent to precedent, war became a barbaric anachronism, and ever-increasing prosperity followed inevitably from the proper understanding of eternal economic laws. Marx and Engels were the first to point out that this apparent calm development concealed the most violent conflicts and that these conflicts were not likely to be resolved in any continuous way, but in a series of ever-increasing economic, political, and military crises.

The new way of looking at science comes, therefore, both from within and from without the field of scientific study. The value of the "Dialectics of Nature" is that it is the first sketch of that new view. It is not in fact more than a sketch. Apart from a masterly introduction which sums up the historic and economic view of scientific thought, and three or four chapters devoted to mechanics and physics, we have merely disconnected notes for a book that was never written. But what they lose in order and finish of presentation, they gain in freshness. We have here the immediate impact of Engels' mind on the scientific problems of the day, and we get from it, as Prof. Haldane points out in the preface, an invaluable impression of how to tackle fundamental scientific problems in a new way. To read Engels at all requires abandonment of the fixed prejudices, dear to the traditional English men of science, that science is non-political and non-philosophic. Engels will have none of these limitations and he says why :

"Natural scientists believe that they free themselves from philosophy by ignoring it or abusing it. They cannot, however, make any headway without thought, and for thought they need thought determinations. But they take these categories unreflectingly from the common consciousness of so-called educated persons, which is dominated by the relics of long obsolete philosophies, or from the little bit of philosophy compulsorily listened to at the university (which is not only fragmentary, but also a medley of views of people belonging to the most varied and usually the worst schools), or from uncritical and unsystematic reading of philosophical writings of all kinds. Hence they are no less in bondage to philosophy, but unfortunately in most cases to the worst philosophy, and those who abuse philosophy most are slaves to precisely the worst vulgarized relics of the worst philosophers." (pp. 183–84.)

The philosophy that Engels introduces into science is derived from that of Hegel, but it bases itself, thanks to Marx's intuition, on the actual world of matter and history, and does not claim an abstract priority of pure thought. This Hegelian origin has been enough to turn many scientific workers, even those most sympathetic to the results of Marxist analyses, such as Prof. Hogben, against their philosophic bases. But actually, as Engels has pointed out, the leading ideas are neither very complex nor paradoxical—they are almost commonplaces ; the value of stating them is that of making them conscious and no longer implicit. For convenience they have been reduced to a small number of phrases, such as the negation of the negation, or the transformation of quantity into quality, but these phrases are merely labels for aspects of material transformations which can be grasped only through their examples, and such examples are given very fully in the "Dialectics of Nature". The fundamental concepts are on one hand the historic unity of the universe in its transition from cosmic chaos to human society on the surface of a minor planet ; and on the other the continual series of struggles and interactions by which are brought about the sequence of transformations that mark off different stages in that development. The sciences of physics, chemistry, biology, and sociology are seen as a hierarchy, not only of complexity but also of time. Each is dependent on the coming into existence of its field of organization. The jumps between one field and the next, as between physics and chemistry, or chemistry and biology, are determined by the conditions operating in the prior field. To resort to an external causal agent is to beg the question ; as Engels wrote, "God = Nescio". The primary condition for the appearance of a new stage is the lack of balance in the older one, a failure in the equilibrium of contrary tendencies. These tendencies are apparent at every stage.

Engels will have nothing to do with special forces, which are merely a means of concealing ignorance. For him everything reduces to matter itself and its forms of motion. At the physical level he considers attraction and repulsion as the characteristic opposite forms of motion. They are not, however, simple motions to and from a point. They correspond rather to potential and kinetic

energy of the system. However much they may change places, they never cancel each other out. The modern atom in its half quantum ground state would have been exactly the kind of thing that would have appealed to his imaginative understanding. In another way he was also surprisingly modern; he refers to atoms themselves and molecules not as fixed unalterable units but as nodal points in a series of movements and transformations.

It is, however, in his approach to biology and sociology, where the material is more tractable without the need for the mass attack of the physical laboratory, that Engels' ideas seem more positively fruitful even to-day. His views on the origin of life and its necessary dependency on the pre-formation of complex carbon compounds—"life is the mode of motion of proteins"—is still in advance of that held by many biologists and scientific philosophers of to-day. In organic evolution he was shrewd enough to see that the simple Darwinian picture is too crude a translation of the ethics of free competition into the biological sphere. Here change comes from the struggle, not so much between individuals or species, as between the linked opposites of heredity and adaptation. The inherent tendencies of the organism which embody its history are as relevant as the environmental changes.

With man, as Engels says, we enter history. The characteristic human attributes are to him no longer individual but primarily social. Work, in the sense of activity conditioned by the group, is here the differentiating factor between man and animals:

"The normal existence of animals is given by the conditions in which they live and to which they adapt themselves—those of man, as soon as he differentiates himself from the animal in the narrower sense, have as yet never been present, and are only to be elaborated by the ensuing historical development. Man is the sole animal capable of working his way out of the merely animal state—his normal state is one appropriate to his consciousness, *one to be created by himself*." (p. 187.)

If anyone chooses to look at the "Dialectics of Nature" as a final statement of a philosophy of science, and expect from it any immediate addition to positive scientific knowledge, he probably will put it down as obsolete rubbish. But if he does this, he will miss its chief value and the object for which it was written—not to tell people about the world, but to point out how they can look at it and how they can change it. J. D. BERNAL.

SONS OF CAMBRIDGE

Alumni Cantabrigiensis

A Biographical List of all known Students, Graduates and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. Compiled by Dr. J. A. Venn. Part 2: From 1752 to 1900. Vol. 1: Abbey—Challis. Pp. xii + 550. (Cambridge: At the University Press, 1940.) 150*s*. net.

THE University of Cambridge is deeply indebted to the president of Queens' and his colleagues for the devoted labour with which they have brought so near to completion the great task begun by Dr. Venn and his father thirty years ago. It is a testimony to the value attached to the work by the Syndics of the Press that the volume under review, the first of six dealing with the period 1752–1900, should have been published in the present troublous times.

A comparison of this volume with its predecessors shows naturally that fuller details are known of the individual's career both at the University and in later life than in the more remote periods; something of the romance of the earlier history has perhaps vanished with the years: the old class of student with a career in the learned professions or in public life remains, but new elements have entered, which are making their own contribution to the life of their epoch. The country squire has become the county councillor; new careers like the Indian Civil Service open up; students arrive from the Dominions or India: Jagadis Chandra Bose typified a class of students, unknown in the earlier days, coming from the Far East to study at Cambridge, while Wallis Budge and Thomas Arnold represented the class that went to the Far East to excavate and investigate the great civilizations of the past.

The past tense is used in the preceding sentence because it is not intended in this notice to refer to living persons, though happily many are still alive whose names appear in the volume. These are not so many as they would have been but for the War of 1914–18, which took its heavy toll of Cambridge men, as is abundantly clear from this volume. G. A. Arbuthnot, an ex-M.P., who served for more than a year in a mine-sweeper and was killed in action as a second lieutenant in the Grenadier Guards, is an example of the men we lost serving their country by sea, land and air. Dr. H. Ackroyd,

winner of the Victoria Cross, upheld worthily in 1917 the tradition set up by William Bankes in India in 1858. These men gave their lives for their country—so, too, did statesmen like Arthur Balfour and Henry Campbell Bannerman devote their lives to the service of their fellows.

Edward Bulwer Lytton and Augustine Birrell provide a link between statesmen and literature, which is represented by Samuel Butler and Byron; on the lighter side we have Calverley, Burnand of *Punch* fame, and Bowen of the Harrow songs. Byron's name suggests the first cricket match between Eton and Harrow, when W. D. Brockman played in Byron's eleven. The careers of many a famous 'blue' in the major sports provide interesting reading; the older sport of travel figures freely, and B. Armytage provides an early link between Cambridge and the Antarctic, while J. Buchanan, the oceanographer, was on the *Challenger* expedition; J. L. Burchhardt, the noted traveller, left his Oriental manuscripts to Cambridge because he there received his earliest lessons in Arabic, and E. G. Browne came back from Persia to the University the leading authority on Persian literature. W. W. Cassels of the "Cambridge Seven" and C. F. Andrews represent groups of Cambridge men who travelled to the Far East and other lands on a different type of mission.

Pioneers of many sides of life are to be found, such as J. M. Bacon, an early experimenter with balloons; William Cecil, the inventor of the internal combustion engine; F. A. Abel, who discovered cordite. The results of their work may be viewed with mixed feelings to-day, but there will be general appreciation of W. F. Broadwood, who made the first grand piano. Music brings to mind Sterndale Bennett, professor of music in the University.

Professors on the scientific side include J. C. Adams, Clifford Allbutt, F. M. Balfour, W. Bateson and A. Cayley: their work needs no description in these columns. Others whose names catch the eye are G. B. Airy, astronomer royal, James Alderson, president of the Royal College of Physicians, Babbage of the calculating machine, 'Beetles' Babington, Dr. Bright of Bright's disease, Ernest Brown and R. C. Carrington, whose names are associated with studies of the moon and sun respectively; also H. K. Anderson, a great University administrator whose name is rightly linked with the new University library. Among librarians the name of Henry Bradshawe stands out. Cambridge families whose members have served their University and their country with distinction in many walks of life must not be forgotten: the names of Balfour, Benson, Brett, Butler, Buxton, Cavendish and Cecil (of Burghley) may be taken as a representative selection.

There remain for mention a few who live in memory for some less obvious reason. Thus we have R. Anlezark, who would eat a leg of mutton at a sitting; Richard Budd had a nursemaid Emma, afterwards Lady Hamilton (Nelson's Emma), and a housemaid, afterwards a celebrated actress, Mrs. Powell; C. F. Burrell brought forward persistently in Parliament a bill to prohibit window-cleaning by females; Dr. Barnardo was the famous friend of waifs and strays, and we must not omit to mention Oscar Browning, "the O.B.", "absurd, profound and above all human"—no bad epitaph for a university don.

F. J. M. STRATTON.

ELEMENTARY ANIMAL BEHAVIOUR

The Orientation of Animals

Kineses, Taxes and Compass Reactions. By Gottfried S. Fraenkel and Donald L. Gunn. (Monographs on Animal Biology.) Pp. viii+352+10 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 21*s.* net.

SINCE Jacques Loeb formulated his tropism theory some fifty years ago, a vast amount of work has been done on the orientation of the lower animals in relation to light and other environmental stimuli. This is well summarized and discussed in the present volume by Drs. Fraenkel and Gunn. In its original form the theory of Loeb cannot be upheld; a classification of these elementary reactions proposed by Kühn in 1919 has to a large extent taken its place in the minds of those who approach animal behaviour from the physiological point of view. It is to Fraenkel that we owe the first full exposition of Kühn's views published in Great Britain (1931), and to Gunn the revised and modified classification here presented in the first part of the book. He distinguishes between kineses or undirected reactions, taxes or directed reactions, and transverse orientations (to light and gravity). Kineses are subdivided into ortho-kineses and klino-kineses, and taxes into klino-taxes, tropo-taxes, and telotaxes. In the second part of the book the available data about these reactions are considered under the headings of the different kinds of external factors "which control them"—temperature reactions,

gravity reactions, reactions to chemical stimuli and so on. Many of these chapters are exceedingly valuable to the serious student by reason of the wealth of references and the careful exposition of the most modern work on the subject. The book is very well indexed and there is an extensive bibliography.

There is at present much diversity of opinion as to the proper method of approaching the study of animal behaviour. Some hold that a psychological interpretation is necessary, others that a purely physiological treatment will suffice. The authors appear to reject the former alternative as being "anthropomorphic", and to cling to the old Loebian conception of the animal as a mechanism actuated by stimuli. Thus they describe their book as "principally concerned with the way in which the various external factors—light, smells, currents, heat, and so on—operate the living mechanisms and lead to orientation" (p. 3). Yet they admit that the behaviour of a rat in learning a maze "cannot be described otherwise than in terms of memory or purpose, whether they are overtly so or not" (p. 316). Their attitude seems to be that mechanistic interpretations must be pushed as far as they will go, but supplemented by psychological if the facts absolutely demand it. I do not think this is a very satisfactory position, and I doubt very much the value of treating even elementary behaviour in terms of kineses and taxes; it seems to me too *simpliciste* and abiological. To my mind a psychological and biological interpretation is required all through, and I agree with Bierens de Haan (1940) in thinking that these orientation responses are best regarded as instinctive behaviour of a simple kind, biologically significant in relation to the normal environment and the normal needs of the animal, though not consciously purposive. Some approach to this point of view is indicated on p. 190, where it is recognized that light is often a 'token' stimulus, representing something of biological significance. The authors are well aware of the methodological difficulties in the study of animal behaviour and discuss them at some length, though not very conclusively.

E. S. RUSSELL.

TECHNICAL DYNAMICS

Technische Dynamik

Von Prof. C. B. Biezeno und Prof. R. Grammel. Pp. xii + 1056. (Berlin: Julius Springer, 1939.) 78 gold marks.

IN introducing the student to technical mechanics either by lectures or text-book it is usual to lay stress on those simplified problems which illustrate the principles. The more difficult problems in the form in which they face the mechanical engineer, even if touched upon, do not receive the detailed consideration which their importance not only warrants but demands. The present book is designed to form a continuation of the introductory course and may be described as a treatise on technical applications of elastomechanics for advanced students.

According to Kirchhoffe's definition, mechanics consists of kinematics, or the study of motion, and of dynamics, or the study of forces. In this sense dynamics can be divided into statics, the geometry of forces and the theory of equilibrium, and into kinetics, the theory of forces not in equilibrium and the relations between force and motion. For example, an oscillation problem is a dynamical one consisting of a statical part, namely, the investigation of certain elastic properties, and a kinetic part, the calculation of the frequencies. The looser current usage takes dynamics as a synonym of kinetics, and while still describing the oscillation problem as dynamical, neglects the statical part, which is often the more difficult if not the more interesting.

The authors use dynamics in the sense defined by Kirchhoff, and have accordingly investigated both the statical and kinetic parts of a variety of problems concerning rods, shafts, rings, springs, plates, shells and their combinations, keeping in view that any such problem is only worth solving when it has a practical application, and can only be described as solved when a detailed solution in numbers is forthcoming without recourse to too prohibitive numerical calculations. It must not be inferred that the book is a wearisome list of numerical results. On the contrary, great emphasis has been laid on methods of solution; in fact a chapter of 100 pages is devoted entirely to such methods. In the applications, solutions are not merely outlined but are given in full as the engineer would have to work them, and with the choice of method which the authors consider to be the best.

The text is divided into four sections: fundamental theory, 225 pages; single parts of mechanisms, 400 pages; the steam turbine, 220 pages; internal combustion engines, 210 pages.

The first section contains an exposition of the mathematical theory of elasticity as applied to isotropic bodies which obey Hooke's law; indeed

phenomena outside the elastic limit are not considered in the sequel. This account of the theory is well and carefully written. It is refreshing to see the authors emphasize the strict limitations of the theorem of unique solution of elastic problems, in that in actuality finite (but small) strains and finite (but not small) stresses represent only approximations to the conditions in which the classical equations are valid. A simple illustration is Euler's strut at the first critical load. Another welcome feature is the inclusion of the proof of de Saint Venant's principle based on that given by Zanaboni (*Atti Lincei*, 25 ; 1937). With regard to the general theorems of elasticity it is to be regretted that the authors have not given the vector formulation which makes the physical implications much easier to grasp.

The remaining three sections consist of applications of elasto-mechanical theory with special emphasis on the needs of machine construction. Special prominence is given throughout to critical loads and values.

The authors remark in the preface that the chapters have been arranged so far as possible so that each can be read independently. This has been achieved within limitations, but the text requires close attention on the part of the reader, who is assumed to be proficient in elementary mechanics and to have a fairly extensive knowledge of mathematics.

The book is a mine of detailed information such as could probably not be found in collected form elsewhere (for example there are 89 pages on the loaded rod) and it should therefore prove to be of great value, and, one regrets to add, of great cost.

L. M. MILNE-THOMSON.

MODERN DRUG THERAPY

Modern Drugs in General Practice

By Dr. Ethel Browning. Pp. vii + 236. (London : Edward Arnold and Co., 1940.) 10*s*. 6*d*. net.

IT has been said that prontosil with its colourless prototype sulphanilamide are destined to be regarded as one of the greatest boons to mankind conferred by the present age. Having regard to that opinion, which few will dispute, the author is not without justification in devoting one-sixth part of a book on modern drugs to the sulphonamides ; indeed, had it been thought necessary to extend this not-too-long chapter, a few of the eleven pages on gold salts might have been spared, for, admittedly, gold therapy is strictly limited in its applications.

Experience in the treatment of the war-wounds of the civil population during the past few months, and even the past few weeks, has added to our knowledge of the richness and even the shortcomings of the sulphonamides, which, of course, can only be recorded in current literature, but nevertheless can be the more readily appreciated against a background such as Dr. Browning has provided. Another topical chapter is the one concerning external applications and local anæsthetics ; again, in this connexion, much has been learnt, in recent months, in the grim school of experience ; much is still being learnt.

When this book was commenced, and even when the labour was over, it was generally believed that tannic acid was the dressing *par excellence* for burns, but in the past few weeks it has been shown that there are pitfalls in its way, and that in no circumstances should tannic acid preparations be used on burns of the hands or face. It should be noted that Dr. Browning puts it on record that gentian violet has been found in many cases more efficacious than tannic acid as a remedy for burns, especially when combined with other antiseptic dyes, and mentions that a successful method for severe and extensive burns is to combine gentian violet, brilliant green and acriflavine as a 'three-dye' mixture which forms a stable solution, relieves pain, forms an eschar, thinner but more flexible than that formed by tannic acid, and obviates the preliminary cleaning-up which is so painful and likely to increase shock in cases of extensive burning. Incidentally, a jelly containing gentian violet and merthiolate (sodium ethylmercurithiosalicylate) was recently substituted for tannic-acid jelly as a first-aid application in the Navy and Royal Air Force.

Nearly half the chapter on cardiac drugs is devoted to the digitalis group ; digitalis, although it has been known to medicine for centuries, is not out of place in a treatise on modern drugs if only for the reason that its glucosidal derivatives, as, for example, digitoxin, digoxin, digalen, and so on, which have to some extent replaced in clinical practice the older galenical preparations, are of comparatively recent introduction. Other chapters deal helpfully with drugs acting on the autonomic nervous system, diuretic and urinary antiseptics, and sedatives and hypnotics. The "easy availability" of the barbiturates, referred to in the pages dealing with sedatives and hypnotics, is no longer a ground for objection to the valuable drugs in this group, since the Poison Rules prohibit their use except under medical supervision.

MENTAL HEALTH IN WAR-TIME*

By SIR WALTER LANGDON-BROWN

IF there is one thing which is certain about the outbreak of wars, it is that the ostensible reason is not the real one. Emotional causes are always transformed into ones alleged to be rational. We know that when a quarrel blazes up between two individuals over a trivial matter, there are deep-seated and hidden causes of antagonism at work. In the same way, no one to-day believes the shooting of an archduke by an insignificant conspirator was the real cause of a war which devastated a large part of the globe for more than four years and cost millions of lives. The cause lay deeper.

Sir Flinders Petrie, in his delightful little book, "The Revolutions of Civilization", maintains that each civilization goes through a cycle, waxing, flourishing and waning in turn. He plotted this out in curves, based on certain recurring features in each civilization. Now the interesting point is that, whether one agrees or disagrees with his views, in this book published in 1911, his curve for the present civilization cut the base line in about 1914. In my Maudsley lecture for 1936 I directed attention to Sir Arthur Keith's dictum that there are two opposing tendencies in life—one the general demand for the enlargement of the social unit—the other the species-making impulse which attempts to segregate a particular type. I ventured to point out that in human life the first makes for internationalism, the second for nationalism. The fierce fanatical outbreak of nationalism which this century has witnessed becomes comprehensible as a frightened response of the species-making segregating impulse against the imperious, resistless demand of the ever-widening evolutionary process towards internationalism.

Now amid all the differences between schools of psychology, there is general agreement on this point—if a normal healthy impulse is forcibly repressed it is apt to come to the surface again in an abnormal pathological form. If this evolutionary demand comes into opposition with a nation that is at once convinced that its culture is the only one really worth having, and is filled with the spirit of aggression, the result is not difficult to predict; and though that spirit of aggression was temporarily checked, the consequences to civilization proved more serious than was realized at the time of the Armistice in 1918.

We now see that the years 1918–1939 were but a troubled armistice between two wars, during which the building up of vertical walls between nations was countered by horizontal lines of cleavage, which threatened to divide Europe into Fascists and Communists. This to my mind represented the pathological form of internationalism resulting from repression of its normal expression. The well-intentioned League of Nations was quite inadequate to deal with the resulting situation. Then extremes met in the Russo-German pact which indicated a new orientation, the division now being between those nations which considered that the individual existed for the State, even though "the State" meant a few autocrats, and those which thought the State existed for the individual. Meanwhile, amid these pathological manifestations an internationalism was arising, and one which seems to us normal and healthy, in the free association of nations within our own dominions. Since the military, political and moral collapse of France, the United States has been thrown into closer relations with that association, and there are clear indications that this process is likely to extend.

This, then, seems to me the background against which the present War is being waged; a moral and spiritual disease in Europe as the result of attempts to stem the tide of the evolutionary process. Also we can admit that on our side the idea of liberty has been too negative, and that we have not formulated a positive conception that is sufficiently adequate for the situation.

Let us now turn to the effect of all this on the mental health both of the community and the individual. One is rather tired of the platitude that the child is father to the man, and yet to-day I am forcibly reminded of it. Watch a child playing with his bricks and carefully constructing an elaborate edifice. Then suddenly his mood changes and with a scream of delight he knocks the whole thing over with a sweep of his arm. It makes us realize that from the first both constructive and destructive impulses are present in the human mind and that there appear to be epochs when the destructive one simply runs amok. Such an epoch we are now passing through. Of course this impulse is rationalized, and it is claimed that the old state of affairs was so bad that it had to be destroyed before anything better could take its place. I do not believe that applies to a complex civilization; but, then, I believe in evolution and not in revolution.

The common man wants to be left in peace with his wife and family and carry on his ordinary

* From a Chadwick Public Lecture delivered at the Royal Society of Tropical Medicine and Hygiene on February 4.

avocations. Unless those are threatened, only the adventurous want to fight. Therefore it has always been a common device of absolute rulers to distract attention from internal difficulties by telling their peoples that some other nation is trying to deprive them of their heritage. As we are gregarious animals, we close our ranks at a hint of danger. The thrill of alarm brings also a new sense of unity; men cannot bear to feel isolated, and barriers break down. A new spirit of tolerance and good will springs up with a readiness to sacrifice to a common end. All this is to the good, but these earlier effects are not always lasting.

Nations at war look instinctively for a leader. Whatever else he does or lacks he must capture the imagination. He must be regarded as a superman, but with some appealing traits. It does not matter if the leader is credited with characteristics he does not possess; the virtues of Kitchener and Hindenburg were great, but not identical with the popular estimate of them.

Prof. Jung must have been prophetically inspired when he said in a lecture in Vienna as long ago as 1932 (and I am only condensing his remarks without adding to them):—

"Everything could be left as it was if a new way of life were not absolutely demanding to be discovered and was not visiting humanity with all the plagues of Egypt until it is found. Instead of being exposed to wild beasts, tumbling rocks and inundating waters, man is exposed to-day to the elemental forces of his own psyche, and so he seeks with more intensity than ever for personal leadership. This is an indestructible human need, but once tradition has been sufficiently lopped off by the revolutionary, unhistorical and therefore uneducated inclinations of the new generation, leadership is the more fanatically defended the more unsuitable it is."

Leadership, then, is a necessity, and as in so many aspects of war mentality, the emotional predominates over the intellectual assessment of the value of the leader. From the South African War onwards I have been struck with the 'writing-up' of leading generals, obviously to inspire confidence in them, a confidence which in several instances was proved by subsequent events to have been misplaced. A leader who can both arouse emotion and appeal to reason is indeed an asset—and we believe that we have such a one.

In ancient times the supremacy of the emotional over the rational attitude expressed itself in consultation of augurs and omens and of ritual observances before going to war, as an attempt to allay inner anxiety and guilt. When war comes, each side firmly and fiercely denies its responsibility, however obvious the facts may be. Indeed, the guilty party is usually the more vociferous in its denials because deep down it feels the truth of the indictment. Then in times of national anxiety there is a regression to certain primitive mental traits. This was well illustrated in Germany by the ritual of driving nails into the gigantic wooden image of Hindenburg, a totem figure of the tribe. A commoner tendency is the making of myths—an escape from reality into fantasy. In the early days of the War of 1914–18, the myths of the angels at Mons, and of the Russian troops passing through England, were widely believed. War had seemed incredible, and these consequences seemed no more incredible. This time war has been threatening for so long that there was not the suitable atmosphere for the propagation of such naïve myths, and people have more sense of reality now. Local rumours exaggerating the damage done by air raids have, however, been abundant. Curiously enough, spreading bad news appeals to vanity. Where facts are few, rumours are rife. The best cure for rumour is information. From the frequency with which Virgil refers to rumour, we may surmise that the Romans were plagued by it. Rumour, he said, "has a hundred tongues, a hundred mouths, a voice of iron". Again, "Rumour, than which no evil thing of any kind is more swift, increases with travel and gains strength by its progress." Since then a swifter method of spreading false reports has been bestowed on the world by science in wireless. Thereby the power of the lie has been enormously enhanced. Truth seems to be a very plodding tortoise compared with the racing hare of lies.

Now all those traits—the demand for leadership good or bad, the reliance on myth and rumour—arise from the same cause; as gregarious animals we are always suggestible, and never more so than when we are in danger. As Mr. Wilfred Trotter pointed out, the physical dependence of the infant develops later into suggestibility which is psychic dependence, a necessary pre-requisite of group life and activity. The dependence of infantile life thus develops into the inter-dependence of social and communal life. It was the greatest weakness of Thomas Hobbes' philosophy that he tried to deal with man as a separate unit—*in vacuo*, as it were. This is impossible. The right course is to canalize this inevitable suggestibility, heightened as it is in war-time, into co-operation.

The greatest enemy to be overcome is fear. For years insidious propaganda has skilfully instilled fear like a creeping poison until, as we have seen, nation after nation has just waited its turn like a rabbit paralysed by terror at the stealthy approach of the stoat that will presently seize it by the throat. It may well be that this could never have happened if at the very moment when nationalism seemed at its very height, there had not been a

subconscious feeling that nationalism itself would prove to have been decaying at the roots. It is worth while, then, to inquire into the genesis of fear. It is the survival, and sometimes the perversion, of a defensive mechanism of great antiquity and real value; alertness in the presence of danger, by which the whole organism is keyed up, ready for action. It is activated through the sympathetic nervous system, which prepares the body for fight or flight. But if action be prevented, the same mechanism produces fright. Then, as Crile puts it, we become like motor-cars with the clutch thrown out; petrol is consumed, and the whole car may tremble from the violent action of the engine, but the car does not move. This is the scientific explanation of the fact that the best corrective of fear is action.

Psychologists tell us that an unconscious persistence of an infantile sense of guilt is a large element in exciting fear. That may be so, but it does not help when the sirens sound; there is no time then to be analysed and have our infantile fantasies exorcised! A distressing form of fear is that which comes from being afraid of being frightened. This is clearly due to a conflict between two powerful instincts—the instinct of self-preservation and the herd instinct, which strongly condemns what seems like cowardice. Action as a member of a community, especially if under suitable leadership, is the best antidote.

Dr. W. R. Bion, who has recently written helpfully on community feeling in war-time, considers that the civilian is at a disadvantage compared with the soldier, in that he has not had the disciplinary training. The soldier can form a tolerably accurate picture drawn from experience of similar conditions; the novice tends to be flooded with emotions which he cannot check by appeal to facts. There is even a chance that the aggressive component of these emotions will be directed towards his own side rather than towards the enemy.

The soldier is a member of a close unit expressly designed for facing tasks which involve the possibility of death, whereas the civilian has no really powerful check to his natural desire for self-preservation and may be isolated in a way which causes a loss of social sense. The strain will be diminished for those civilians who are serving in some organization which has definite clear-cut aims, with powerful emotional appeals and a discipline. It is necessary to find some modification of the disciplinary framework that exists in a fighting service and to adapt its organization to the needs of the civil population.

Dr. Bion quotes from Tacitus a description of the conduct of the German tribes warring against the Roman troops of the Emperor Trajan—of the way that they inflamed their minds with barbarous poetry (in a hymn of hate), the furious uproar, their uncouth and harsh vociferation, interrupted at intervals by the application of their bucklers to their mouths, so that the noises burst out with redoubled force. Students of infant behaviour have noted that the earliest fear a child experiences is that excited by noise, and the Germans, true to their own tradition, have actually added devices to their shells, whereby the screaming noise of them may be still further increased, so as to arouse a primitive type of fear. This could reasonably be countered by the use of ear plugs, which would be both physically and psychologically protective.

We can understand why pessimism and fear are chiefly prevalent among those who are doing nothing, or at any rate not contributing to our war effort.

The best antidote to fear is action; and we need an antidote, for we cannot expect to be entirely free from fear. The Emperor Charles V, seeing on a Spanish nobleman's tomb the epitaph, "He never knew fear", remarked, "Then he never tried to snuff a candle with his fingers!" Sir Philip Sidney expressed the same idea in more serious style when he wrote, "Fear is more pain than is the pain it fears".

The general experience, however, so far, bears out the report of a conference of medical men convened by the Minister of Pensions before the active stage of war began. They stated that a very exaggerated estimate had been formed of the liability of war to produce nervous breakdown. This has been amply substantiated since the intensified air raids on Great Britain have been in progress, and that in spite of all the suffering and loss that have resulted. A writer in the *British Medical Journal* explains this in an interesting way thus: "With the constant threat to the existence of the entire community constituted by repeated and indiscriminate bombing, a superb scapegoat is at hand. . . . The facility with which one can now project one's fears and anxieties is likely to be the most important one" in preventing such breakdowns. "The herding together of individuals in shelters in the face of common danger and the levelling-out process in society which is consequent upon universal hardship have no doubt been essentially responsible. Further, the opportunity for dramatization afforded by narrow escapes, etc., is a decided factor."

During the Spanish Civil War it was found that in Barcelona, a particularly heavily bombed city, nervous breakdowns were neither numerous nor severe. An interesting comment on this was made by a German refugee professor, now in Great Britain, to the effect that in a civil war everyone fanatically takes one side or the other, while in a war between nations the individual is less

personally involved. As this professor served in the German army in the War of 1914–18, this view is specially interesting, because if individual Germans felt that way then, it is almost certain they feel more so now. It is also reassuring to have confirmation of our belief that confidence in the justice of a cause is a splendid preventive of nervous breakdowns. That confidence we possess.

The danger underlying herd feeling is panic, for we are suggestible in a wrong as well as a right direction. Therefore anyone who goes about suggesting that an epidemic of nervous breakdown is likely, for which there is really no warrant, is doing what he can to produce panic. In the War of 1914–18 the populace was singularly free from panic, as it is now under much more trying conditions, and it was rather surprising that before Munich there were symptoms of this dangerous response to danger. The intervening eleven months seemed to steady the nerves of the people of Great Britain and to transpose the liability to panic on to some of our administrators.

By what other methods besides co-operative action can we help to preserve mental health in war-time? Physical fitness undoubtedly helps. I remember in the War of 1914–18 a man telling me that it was his duty every night to take supplies up to the front line, which he did without fear, until one night when he had a severe cold; on that night he experienced acute fear.

To obtain sufficient sleep is also essential to maintaining physical fitness. Rather than disturbing rest by a flight to a shelter, in many cases it is sufficient to arrange bedrooms on the ground floor or in the basement. I am reminded of the old controversy whether to shelter under a tree in a thunderstorm or not. You have to put the remote prospect of that tree being struck by lightning against the much greater chance of a severe chill from getting soaked. Poincaré, the mathematician, and brother of the politician, said during the air raids on Paris during the War of 1914–18: "I sleep securely under the shelter of the laws of probability." However, the probabilities are less favourable now than in that war.

It is clear from the report of Lord Horder's Committee that the conditions obtaining in many shelters are not conducive to physical fitness, to put it very mildly. If we are to be condemned to revert to the cave man's existence, there is no reason why we should also revert to his primitive ideas of sanitation.

Cheerful surroundings help to banish fear. The Germans proclaimed a war of nerves months before hostilities began, and they have gained considerable success by the menace of air raids which has necessitated the 'black-out' with its depressing effect. If there must be darkness without, there can be and should be light within. You absorb more from rooms furnished and decorated to your taste than perhaps you imagine. You think you have ceased to notice a charming picture on your walls until it is taken away. Then you miss it at once, which shows it was always exerting its effect, although you were apparently unaware of it. That is where life in shelters is apt to have an evil effect in this war of nerves.

Books are a great solace these dark nights. I am enjoying renewing my acquaintance with that fine English literature of the last century which this restless age has been neglecting to its own disadvantage.

Do not omit to meet your friends, and if rationing compels simpler hospitality, remember that in the eighties of last century this was generally the custom, and we were certainly not less happy. Then there is the radio. Needlework reached artistic heights during the Napoleonic Wars; the creation of beautiful things always has a cheering influence. If you are feeling too geared up, lie down, close your eyes, breathe deeply and relax all your muscles. Do it for twenty minutes at a time. This is a great help, for you can waste a lot of nervous energy by just uselessly tightening up your muscles if you are feeling frightened. But the main thing to do is to change useless muscular action into some useful activity.

We have reserves of tenacity and endurance, inherited and maintained through generations of stable and equable ancestors. Boswell once said of some behaviour of Dr. Johnson to his College tutor, "That, sir, was great fortitude of mind", to which Johnson replied, "No, sir, stark insensibility." I do not think our national fortitude is based on insensibility. We may well scoff at pretentious and unjustified claims made elsewhere to racial purity. We are the product of the fusion of many tribes, from which something new emerged, differing from its original constituents as much as an amalgam of metals differs from its separate ingredients; a people liberty-loving, tolerant, humorous but reticent, steadfast but quite unwilling to look unpleasant facts in the face until compelled to do so. Thus, though a peace-loving nation, when we do get roused we become the more fierce precisely because we resent the necessity for it. Just a century ago de Tocqueville said of democratic peoples, "The same passions which made them attach so much importance to the maintenance of peace will be turned to arms. . . . Hence it is that the self-same democratic nations which are so reluctant to engage in hostilities sometimes perform prodigious achievements when they have taken the field."

In the interests of our mental health we must be determined to carry on in the same liberty-loving spirit into the peace, which will have its own special

difficulties. Prof. R. B. Mowat, in an interesting article, has pointed out that, from the French Revolution to the Battle of Waterloo, the whole of Europe was in the melting-pot before the impetus of that revolution was exhausted. In the same way it has been again in the melting-pot since 1914, and again we may expect the impetus of this revolution to die down. Then, as before, will come the period of reconstruction. What kind of world will arise depends much on our attitude now—it will decide whether the melting-pot is to be a witch's cauldron or a refiner's fire.

If we are to escape future disasters we must learn more about ourselves and our own nature. The ancient Greeks, and in our time Thomas Hardy, regarded man as the sport of inevitable fate ; the modern psychologist shows us that fate is the outcome of individual and national temperament. The future is ours to redeem, and this can only be achieved by self-knowledge and mutual sympathy. One of the direst aftermaths of war is an inevitable hardening of the boundaries between nations and the withdrawal of feelings towards international sympathies. That is why the League of Nations failed, and why for the present federal union can only remain a dream. Nevertheless, it is an excellent thing to talk about federal union ; it took years of talk to accustom men's minds to something so obviously right as the abolition of slavery.

Yet a more international spirit will have to arise if civilization is to be saved. Isolation in thought and ideals is absurd at the very time when wireless has joined up the whole world and it has become increasingly clear that even material prosperity depends on commerce being international. Peace must mean more than simply the cessation of war ; it must be based on a new spirit of co-operation and we must hope for its emergence from the refiner's fire. H. G. Wells has said that the only chance of ever becoming more reasonable is by realizing how unreasonable we are ; to which one might add—and by trying to understand why we are so unreasonable. Recent events have proved that, under the superficial crust of civilization, the age-long forces of savagery and brute instinct are still alive. To recognize their existence is the first step to canalizing their energy in right directions. "In man's very flesh and bones is the impulse towards closer and closer union in larger and larger fellowship. To-day he is fighting his way towards that goal." The path is difficult and will be fraught with many disappointments as in the past. It was recently remarked that the problem of the future is to combine individual freedom with collective responsibility. On whether we can achieve this or not depends the future of civilization. The world stands at the parting of the ways.

THE OIL/WATER INTERFACE

By Dr. J. H. Schulman,
Department of Colloid Science, Cambridge

A JOINT meeting of the Faraday Society and the Physical Society was held in London on January 9 to discuss the oil/water interface. In spite of adverse conditions which prevail at the moment for such meetings, and the impossibility of the meeting taking on its usual international atmosphere, the room was quickly filled beyond capacity. There were also some of our Dutch, Belgian and Greek colleagues present to keep alive the spirit of international collaboration in science, fostered by the Faraday Society discussions. The discussion, which was opened by the president, Prof. E. K. Rideal, was at times very animated. The president stressed the implications this subject has on a very large number of scientific and industrial fields, and the papers read were divided into biological, physical, chemical (emulsions), and theoretical sections.

The chief aspects dealt with in the papers read were the influence of the chemistry and structure of the interface on the adsorption and diffusion of ions and molecules on to and through the interface and on the kinetics of reactions taking place at the interface ; likewise also, the influence the chemistry and structure of the ion or molecule has on the above factors.

Dr. A. E. Alexander (Cambridge) started the discussion by giving a review of the monolayer technique applied to both the air/water and oil/water interfaces, and stressed the use which a combination of the two methods has on elucidating and predicting phenomena occurring at the interfaces. Attention was directed to the fact that surface potential measurements at an oil/water interface can be made if the ionizing air electrode is in the air above, and not if the ionizing electrode is in the oil layer just above the interface. The oil layer has to be of the order of only 1 mm. or 2 mm. in thickness.

The discussion then centred on the fact that

at the oil/water or air/water interface the equation of state for substances examined by Alexander and Teorell gave 3/2 KT instead of KT as previously found by Langmuir.

It was pointed out by A. B. D. Cassie and R. C. Palmer (Leeds) in their paper that deriving a surface equation of state for strong electrolyte detergents by a combination of the Poisson, Boltzmann and Gibbs equation gave a factor of 3/2 KT for ionized films as compared with KT for unionized films. They actually used Alexander and Teorell's results to confirm their theoretical deductions. It would appear that the presence of the ionized polar group at the end of the hydrocarbon chain, as compared with an unionized polar group or dipole, is responsible for this 1·5 factor in the equation of state for monolayers at interfaces. A confirmation of this suggestion was considered important.

Dr. G. S. Hartley gave the first demonstration of how simple alterations in the structure of the adsorbing molecule can radically affect interfacial conditions. It is known that the lowering of interfacial tension at the oil/water interface is due to the ions of the paraffin chain salts, and the sudden break in the interfacial tension concentration curve coincides with the formation of micelles.

Hartley reasons, therefore, that by changing the structure of straight single-chain paraffin salt to that of a double-chain salt, two changes in the interfacial tension phenomena curves should take place. First, on changing the configuration of the non-polar portion of the molecule, one alters the adhesion balance of the molecule with the water molecules. Thus, with two chains there would be more accessibility for the water molecule to the hydrocarbon molecule than with one chain; hence the double-chain molecules would have less interfacial activity at identical concentrations. However, since steric factors with the two chains would alter the micelle packing, greater concentrations of the double-chain ions would be required before micelle formation can take place. Thus one should obtain with double-chain molecules a greater lowering of the interfacial tension than with a single-chain molecule containing an equal number of carbon atoms.

This theory is very prettily justified experimentally. Single-chain ions of sixteen carbon atoms, or double-chain ions with one long and one short chain, lower the interfacial tension at low concentrations to a greater extent than double-chain ions of eight carbons each. But at higher concentrations the double-chain ions lower the interfacial tension to much smaller values than the single-chain ions. This fact is well demonstrated by the spontaneous emulsifying properties of sodium dioctyl sulphate (Tergitol) as the agent in an oil-in-water system as compared with sodium cetyl sulphate, showing that there must be a very low interfacial tension of the solution of the double-chain molecules.

A. C. Frazer (London), J. F. Danielli and J. H. Schulman (Cambridge) showed how physical chemical studies of interfacial phenomena can be applied to biological problems.

Frazer has established by a series of direct analogies with artificial systems that the particles which exhibit strong Brownian movement in blood plasma are fat emulsions, stabilized by a protein film around each particle. The particles consequently behave as a protected colloid and have all the physical chemical properties of the adsorbed protein and not of the fat of which they are essentially composed. Furthermore, the protein adsorption is specific, since the particles take on the characteristics of the globulin fraction of the serum. Strong support is given from the monolayer and electrophoretic techniques in establishing the fact that fats adsorb preferentially the globulin fraction of the serum and not the albumen fraction.

Discussion immediately centred around this important result. It was considered unlikely that the fats could participate in this specificity, and it was suggested that it was due to some difference in the chemical constitution of the proteins affecting their hydrophobic – hydrophilic balance. The globulins were supposed to have more CH_2 groups in their side chains than the albumens; but on the other hand the serum globulins are known to associate with lipoid substances specifically in the serum, which may account for their ability to adsorb on to fats, etc.

It has been shown by Frazer that this preferential adsorption of the important serum globulin which is associated with the immunity properties of serum, is given also by toxins (bacterial and snake venom) and hormones such as insulin. The biological activity of these substances is completely inhibited when they are in the adsorbed state. Apparently the phenomenon is reversible since, upon the emulsions being broken, the biological action of these substances returns. This is a very good example of how orientation of a molecule or certain components of the molecule at an interface can radically alter its chemical activity (as exemplified by its biological action). The significance of these results was fully appreciated by the meeting.

J. H. Schulman demonstrated how alterations in the structure and orientation of molecules composing the interface can also radically affect the course of a reaction taking place at the oil/water interface. From direct analogies as to the mutual orientation of the hydrocarbon chains attached to the acid and alcohol radical of an aliphatic ester

at an air/water interface, the adsorption of OH^- ions to the interface and the specificity of the digestion of aliphatic esters by ferments can be explained. Thus when the hydrocarbon chains are orientated parallel to one another (*cis* form) leaving unrestricted approach to the polar group from the water phase, adsorption of OH ions can take place together with digestion of the esters by lipoclastic ferments. If the chains are orientated opposite one another (*trans* position) adsorption of OH′ ions is greatly restricted and digestion is completely inhibited. It requires only a 5-carbon atom hydrocarbon chain on the acid radical to bring about complete indigestion of the ester; but 5-carbon atoms on an alcohol radical chain permit the molecule to orientate in the *cis* position and be easily digested. Thus, ethyl valerate is indigestible, but amyl propionate is readily digested by the lipoclastic ferment in pancreatin. The activity of the ferment itself is enhanced by the presence of most paraffin chain salts both positive and negative, except that of the long-chain sulphates, which cause complete inhibition of the ferment action in minute concentrations.

The adsorption of OH′ ions at oil/water interfaces was discussed in some detail following the presentation of results obtained by the school of Prof. W. C. McC. Lewis at Liverpool on the electrophoresis of emulsions or suspensions of oil in water (W. Dickinson and G. Growney).

It was shown that the adsorption varies markedly with a number of factors. In the first place, it varies with the physical nature of the surface, that is, liquid or solid. Discussion took place on the interesting fact that the increase of adsorption of OH ions in alkaline solution on the change from a solid to a liquid is gradual. The melting point gives no marked change. This was explained by the fact that X-ray diagrams of paraffins show no marked change over the melting point. Thus the change in area of the surface molecules in the neighbourhood of the melting point can be considered as changing gradually and not in a sharply defined manner as characterized by the melting point. This also gives an explanation for the apparent anomaly of the adsorption of OH ions on mixtures of ethyl laurate and stearic acid.

Stearic acid alone is a solid, but mixed in small concentrations with ethyl laurate it will give a liquid film of adsorbed stearic acid at the ethyl laurate/water interface. A liquid film of stearic acid will adsorb more OH ions than either a solid film of stearic acid or a liquid film of ethyl laurate.

The adsorption also varies with the stereochemical structure of the oil phase and hydrogen ion concentration. Thus aliphatic long-chain esters fall into three groups: those that are solids which adsorb OH ions poorly; those in which the esters are orientated in the *cis* form, which absorb OH ions gradually with increasing *p*H, and those in which the esters are presumably orientated in the *trans* form, or in a form which only permits adsorption to take place at *p*H 9.

Discussion took place as to the reason why the electrophoretic mobility of ester (or other hydrocarbon compounds) suspensions changes with increasing *p*H until *p*H 9 is reached, and then remains nearly constant. There is no change in the curve over the region where hydrolysis is known to commence. There was no adequate explanation forthcoming for these interesting facts, which may have some bearing on the mechanism of hydrolysis in general.

J. F. Danielli (Cambridge) gave a theoretical interpretation of interfacial phenomena as related to a living cell. The cell membrane consists (to a first approximation) of a thin oil layer with a protein film adsorbed on its two surfaces. A molecule penetrating through the membrane must penetrate (*a*) the external interface, (*b*) diffuse through the thin oil layer, (*c*) penetrate the internal (cytoplasm-oil) interface. Attempts were made to plan the kinetics of diffusion through this system on a quantitative basis: this problem cannot yet be dealt with accurately owing to lack of a theory of diffusion which is cognizant of the influence of structure on diffusion. Some useful preliminary relationships between oil-water partition coefficients and permeability constants have been obtained, and approximate values calculated for the permeability of a thin oil layer to hydroxylic compounds. It was emphasized that with polar compounds the resistance to free penetration lies largely in the necessity of breaking hydrogen bonds between polar groups and water before penetration of the external oil-water interface can occur, and with non-polar compounds the principal resistance lies in the difficulty experienced by hydrocarbons in diffusing from oil into water.

The problem of emulsions was presented by R. C. Pink (Belfast) and A. King (London). The former pointed out that metallic soaps are poor emulsifiers unless they act as solid stabilizing agents. There are three essential functions attached to a solid stabilizing agent essential for emulsion stability. The agent must be insoluble in both phases, but must be wetted by both phases, and the particles must inter-associate to form a stable interfacial layer. A metallic soap which can be readily dispersed in oil acts as a solid stabilizing agent if the action of water precipitates it out of dispersion; thus magnesium oleate gives excellent water-in-oil emulsions, whereas zinc or nickel oleate give no emulsions.

A. King stressed the importance of the inter-

facial film on the stability of emulsions in general as measured by the change of area of the interface with time. Emulsions stabilized by agents such as soaps give much finer emulsions than those stabilized by solids such as alumina, but the former are easily influenced by the presence of salts and temperature, whereas the latter are stable against most conditions, such as salts, temperature and *p*H. The effect of salts of the lyotropic series on emulsions stabilized by saponin are interesting. Thus sulphates increase both stability and viscosity, whereas thiocyanates and iodides markedly reduce these properties of the emulsions.

J. Powney and L. J. Wood (London), in conclusion, brought to the attention of the meeting the interesting fact that whereas electrophoretic mobility of droplets and interfacial surface tension both depend on the formation of interfacial films, in a number of cases no correlation apparently exists between the two phenomena. Thus over very small concentrations of the salts of long-chain sulphates and amines, great changes in electrophoretic mobility (of oil droplets) are observed with no measurable change of interfacial tension. Only over the range of concentration where the electrophoretic mobility is nearly constant does the interfacial tension seem to change in any marked degree.

OBITUARIES

Mr. D. Ward Cutler

THE death of Donald Ward Cutler, head of the Microbiological Department at the Rothamsted Experimental Station, came as a sudden and unexpected shock to his colleagues. He had been at his work as usual, then was suddenly struck down with pneumonia and survived only a few days. He was trained in zoology at Cambridge under Prof. Stanley Gardiner, and after his happy and successful undergraduate years at Queens' College he went to the Marine Biological Station at Plymouth to investigate fish scales. In 1915 he joined Prof. S. J. Hickson's staff at Manchester, where his gift for lecturing and for teaching made him a useful member of the department; in his free time he studied the Protozoa of termites. A weak heart prevented his being accepted for active service, but he gave valuable help in the Pathological Department set up for the Manchester war hospitals and became an expert on amœbic dysentery.

After the War he transferred to Rothamsted to take charge of the microbiological work that had for some time been going on there. His first investigations were on the Protozoa of the soil which had been shown to play an active part in the microbiological processes, and he soon succeeded in clearing up many of the difficulties that had arisen in connexion with them. He confirmed Goodey's observation that the ciliates were probably not very active, and Martin and Lewin's observation that the amœbæ were active, and he showed why amœbæ could not easily be picked out from the soil. In conjunction with L. M. Crump he made daily counts of the numbers of bacteria and of certain Protozoa in the soil of one of the Rothamsted fields, carrying on the work without intermission for a whole year, and so obtained a rich mass of data which has since proved very valuable in soil microbiology. The numbers showed considerable fluctuations from day to day, but the bacteria and the Protozoa fluctuated in opposite directions: when the Protozoan numbers were high those of bacteria were low, and vice versa. This accorded with the view that the Protozoa were acting detrimentally on soil bacteria. Later work, however, showed the operation of another factor: in culture solutions the bacteria generally proved to be more efficient when their numbers were low than when they were high, so that the amount of activity per head of bacterial population was actually increased by the action of the Protozoa.

He also studied the bacterial oxidation of ammonia to nitrate, and showed that this is a commoner property than had been supposed.

In recent years his chief work had been on the purification of effluents from sugar beet and milk factories, an investigation carried out at the request of the Department of Scientific and Industrial Research. He was in charge of the microbiological side and the late E. H. Richards of the chemical side, and the good personal relationships of the two leaders enabled them to bring the work to a satisfactory conclusion. During these investigations much valuable information was accumulated about the decomposition of organic matter by bacteria, and this is now being put together.

Ward Cutler's interests, however, were by no means confined to microbiology. He was an active member of the Councils of the Eugenics Society and of the British Social Hygiene Society, and he wrote two well-known books, "Heredity, Evolution and Adaptation" and "Some Problems in Soil Microbiology". He was also a good lecturer, giving generous service to the Workers' Educational Association and other bodies. For many years, too, he was an enthusiastic supporter of amateur theatricals, wherein he displayed no mean ability. Finally, he had an attractive personality and the great gift of winning the loyal support of his staff.

E. J. RUSSELL.

Prof. D. Robertson

We regret to record the death of Prof. David Robertson on January 8. He was born on December 26, 1875, and like his grandfather, David Robertson, LL.D., the well-known naturalist of Cumbrae, his bent was scientific. Educated at the Hermitage School, Helensburgh, he studied engineering and electricity in the West of Scotland Technical College and the University of Glasgow, where he gained the Sir John Pender Gold Medal, and where he took the degree of B.Sc.(Eng.). Later he was awarded the degree of doctor of science by his own University in recognition of his valuable research work.

After two years as lecturer in the Bradford Technical College, he worked, on original lines, for thirty-eight years in Bristol, where he became professor of electrical engineering in the Merchant Venturers' Technical College in 1902, and in the Faculty of Engineering in the University of Bristol in 1909. He was chairman of the Western Centre of the Institution of Electrical Engineers in 1916, and president of the Bristol Association of Engineers in 1922.

His twenty-seven publications covered a wide field in engineering, and they reflect his character in attention to detail and accurate observation. It makes the achievement of his work so much the greater in that he was confined to an invalid's chair for the last thirty years of his life.

No doubt his works' training in the shops of Messrs. James White, Ltd., was responsible for his great interest in instruments and clocks. "Electrical Meters on Variable Loads" shows the errors which arise under these conditions. "The Clock and Striking Mechanism for the Great Bell of the University of Bristol" gives details of his own design of striking gear, escapement and system of controlling the rate of the clock by means of wireless signals from Greenwich. "The Stroboscope in Speed Measurements and other Engineering Tests" and "The Separation of No-load Stray Losses in Continuous-Current Machines by Stroboscopic Running-Down Method" deal with the principles and application of the stroboscope, and show how the no-load losses can be obtained with accuracy in machines which come to rest in less than one minute. Papers on other subjects include "The Mathematical Design of Transformers", showing how the cheapest transformer for a given output with specified losses is designed; "A Mode of Studying Damped Oscillations by the Aid of Shrinking Vectors", showing in a simple manner how electrical oscillations, or any kind of vibration, can be represented by a vector rotating with uniform angular velocity and, at the same time, shrinking at a uniform rate, so that its path is a spiral.

In recent years he published a very important series of papers on the whirling of shafts and cognate problems. These did much to explain many puzzling phenomena in the running of loaded shafts, and have received high commendation from the special workers in that field. They are notable in the ingenuity displayed in devising experimental methods, and for the criticism of previous work, much of which was mathematical. S. HOLMES.

Mr. J. A. Tomkins

We regret to announce the death of Mr. John Arthur Tomkins. He was born in 1874, and received his early education in London. From the age of fifteen he was apprenticed to a firm of scientific instrument makers, with whom he was connected for many years. Between 1892 and 1898, he attended Birkbeck College and the Royal College of Science, of which he became an associate. At this point he entered the teaching profession at West Ham Technical College, as a lecturer in mathematics and physics, and finally joined the staff of the Bradford Technical College in 1903. There he remained until his retirement in 1939. At Bradford, where he became in fact, if not in recognized status, the head of both the Physics and Applied Optics Departments, his long service has left a lasting memorial.

The skill and knowledge acquired in his youth as an instrument maker went with him during life, and Bradford Technical College is enriched with a number of soundly designed instruments. Tomkins' own interests lay perhaps more in the direction of applied optics than pure physics, and many of his thirty contributions to scientific and technical journals dealt with this side of his work. Such a steady stream of published work from a man overburdened with teaching for so many years, actively working for professional organizations (he had much to do with introducing the Association of Teachers in Technical Institutions into the College), and at the same time administering a double department, is its own tribute to his energy and ability. His outside interests appear to have been few, apart from his membership of the Physical Society and the Institute of Physics, of which he was a founder fellow. Bradford has lost a devoted servant, and the Technical College is severed from one whose thoroughness, strict devotion to duty, and too modest personality were a part of it for nearly forty years. J. P. ANDREWS.

We regret to announce the following deaths:

Father G. Alfani, the well-known Italian seismologist, aged sixty-four.

Prof. P. Broemser, professor of physiology in, and rector of, the University of Munich, formerly professor of physiology in the University of Basle, aged fifty-four.

Prof. W. Bulloch, F.R.S., emeritus professor of bacteriology in the University of London, aged seventy-two.

Mr. S. H. Hamer, C.B.E., secretary during 1911–34 of the National Trust for Places of Historic Interest or Natural Beauty, on February 6.

Prof. R. von Ostertag, formerly director of the Veterinary Department of the German Ministry of Health and of the Veterinary High School, Berlin.

Prof. Vittorio Patti, director of the Rizzoli Institute and professor of orthopædic surgery in the University of Bologna.

Dr. Cresswell Shearer, F.R.S., formerly University lecturer in embryology, Cambridge, on February 7.

NEWS AND VIEWS

Lord Moyne: New Colonial Secretary

THE announcement of Lord Moyne's appointment as H.M. Secretary of State for the Colonies in succession to the late Lord Lloyd will be welcome to all who have at heart the future of the populations of Britain's colonial dependencies. His experience both in and out of office when as the Hon. Walter Edward Guinness he sat in the House of Commons, and his first-hand acquaintance with colonial problems, will secure that even the nation's supreme war effort will not be allowed completely to obscure the claims of the populations, and more especially the backward populations, of Britain's colonial dependencies, nor the measures which have already been initiated for raising the standards of living and health to fall entirely into abeyance, however difficult that task may be. It will be remembered that not only was Lord Moyne head of the financial mission which visited Kenya in 1932, but he was also chairman of the Royal Commission which investigated conditions in the West Indies in 1938. It was on the publication of the report of this Commission and largely in consequence of its findings that the Government initiated its present policy of colonial development through liberal grants from the Imperial Exchequer over a period of years. Lord Moyne's first-hand acquaintance with the problems of backward peoples is not, however, limited to his official relations with them. He has travelled extensively in remoter parts of the world, and the ethnographical objects collected by him, more especially in New Guinea, have added valuable material to the national collections in the Ethnographical Galleries of the British Museum.

Geological Survey of Eire: New Director

MR. D. W. BISHOPP has been appointed director of the Geological Survey of Eire. He received his training in the Geology Department of the Imperial College of Science and Technology, London, and graduated A.R.S.M. in mining geology in 1923. Developing observations made during his field training in Norway, he published his first paper, one dealing with the Sulitelma pyrite deposits, in the *Transactions of the Institute of Mining and Metallurgy*, and in 1924 was awarded the Institute's Student's Prize. He has had wide experience as a mining geologist, having served with the Mazapil Copper Co., Mexico, the African Manganese Co., Gold Coast, etc. In 1928, he was appointed geological curator in the Rhodesian Museum at Bulawayo, and in 1936 he proceeded to British Guiana as Government economic geologist. His publications have dealt with the mineral deposits of Norway, Mexico and especially British Guiana. The appointment of Mr. Bishopp foreshadows a thorough investigation of the mineral possibilities of Eire.

Cyrene: Birthplace of Eratosthenes, 276–196 B.C.

THE advance of the Imperial armies to Cyrene recalls the time when that city was a home of learning and the capital of Pentapolis, a tract of country containing the five cities Cyrene, Arsinde, Berenice, Ptolemais (or Barce) and Appolonia. Cyrene was the birthplace of several learned men, among whom was Eratosthenes, the geometer and mathematician. A personal friend of Archimedes, Eratosthenes was educated at Alexandria and Athens, and for the greater part of his life was in charge of the University library at Alexandria. He was, says Ball, the Admirable Crichton of his age. He constructed instruments which were used for centuries at the University of Alexandria, suggested the calendar in which every fourth year contains 366 days, determined the obliquity of the ecliptic, measured the length of a degree on the earth's surface and attempted to determine the circumference of the earth. In old age he lost his sight, and starved himself to death at the age of eighty-two.

Early Exploration of Kent's Cavern

THE REVEREND JOHN MACENERY, foremost of the early explorers of Kent's Cavern, was born at Limerick in 1797 and was chaplain to the Cary family at Tor Abbey, Torquay, where he died on February 18, 1841. His stone monument is in the cemetery of the Parish Church of Torre, and it states "he inspired respect as a scholar by the vigor of his understanding, his polished taste and varied learning". He made his first visit to Kent's Cavern in the summer of 1825 by chancing to hear a friend express his intention of joining an exploring party there which eventually numbered about a dozen; he made the last of the train, the others spread themselves about but added nothing to what was already known of the cavern, and he betook himself alone to a spot which seemed to have been disturbed. He tumbled it over and found the first fossil teeth he had ever seen; he pursued his search in silence and kept his good fortune to himself, as he "was anxious to send them in the state they were found to Oxford", probably to Prof. Buckland who later in the year visited Kent's Cavern with MacEnery. On that occasion the latter found the tooth of a rhinoceros and a flint blade which he believed was the first ever found in the Cavern.

MacEnery evidently intended to publish his work as he issued a paper as follows: "Shortly will be published, in one volume Quarto, Cavern Researches; or Discoveries of Organic Remains, etc., etc.", but it is likely that he was dissuaded from pursuing the matter as he might come up against ecclesiastical authority. His most interesting finds were the teeth of Machairodus (sabre-tooth) of which he found about eight specimens. These were the first ever

found in Britain and were much prized. He also gathered thousands of specimens of the usual cave fauna as well as flints. Unfortunately, after MacEnery's death the whole of his collections were dispersed by auction, and as the Torquay Natural History Society was founded three years after that date there was no local effort made to keep all his treasures in Torquay, with the result that most of them were purchased by the British Museum and only a few are now in the local museum built by the Society.

Great headway was made between 1865 and 1880, when a very careful exploration of Kent's Cavern was made by a committee of the British Association in which Mr. William Pengelly took the leading part. This resulted in the collection of a very large number of specimens which after supplying the Torquay Museum allowed for the distribution of cave material to many other museums in Britain. The finding of another Machairodus tooth by Pengelly was very satisfactory as there had been some who doubted that MacEnery's had come from Kent's Cavern. Pengelly, by his finding Chellean and other flints, was also instrumental in backing up many of MacEnery's surmises and theories. During the winter of 1925 a Committee of the Torquay Natural History Society was formed to work with a Committee of the British Association for carrying on explorations at the Cavern, and in 1926 a commencement was made at a point selected by the late Prof. Sollas; work has been going on each winter since then up to the present year. In one chamber a depth of thirty-four feet of cave earth has been reached and many fine specimens of flints, teeth and bones have been met with; but the name of MacEnery, the pioneer, is never forgotten.

The American Public and Natural History

ALTHOUGH some aspects of museum activity fail to interest the modern public, the enormous influence of the American Natural History Museum, New York, is cited by Charles Russell in its journal, *Natural History* (Dec. 1940). Statistics show the Museum has: 2,000,000 annual visitors, including its Planetarium; 25,000,000 contacts by its Department of Education; 624,000,000 hour-listening to its radio programmes; 1,000,000 learners taught by its education staff; 200,000 miles a year travelled by museum trucks making 40,000 deliveries to schools, hospitals, prisons, colleges and universities; 480,000 visitors to Bear Mountain trailside museums; 35,000 orders for loan materials outside New York, and 27,000 subscribers to its journal. "The real work of the Museum," states Russell, "is to help people become more aware of themselves and of their surroundings, to help them think in terms of realities, not theories."

When the director of the Museum, Dr. Roy Chapman Andrews, writes a popular animal story about a domestic cat, and the assistant curator of vertebrate palæontology, Edwin H. Colbert, can write an equally engaging story about the sabre-tooth tiger, as is done here, science makes enormous strides in educating the public in palatable, yet truthful, biology. Under "Portrait of a Mammalogist" is given the career of H. E. Anthony, who since 1911 has travelled 200,000 miles collecting for the museum exhibits; the department of mammals, of which he is curator, controls nine of the Institution's twenty-eight exhibition halls with approximately 150,000 specimens. His work on South America's early fossil mammals has been particularly conspicuous and tends to substantiate the theory that up to about 600 million years ago the northern and southern continents were joined by a land bridge even broader than the present central American corridor. American museums seem to be unhampered by that unscientific worship of tradition and the past which leaves many of the smaller British museums without any very useful function in present times.

Life-cycle of Wilson's Petrel

IT is seldom that knowledge of a life-history which has baffled observation for sixty years has been completed so thoroughly as in Brian Robert's account of Wilson's petrel, *Oceanites oceanicus* (British Graham Land Expedition, *Sci. Rep.*, **1**, No. 2, 1940). Three seasons observations at a locality easily accessible and easily worked from the northern base-hut in the Argentine Islands, afforded material for a full description of breeding habits and development, and comparison of populations on different island groups has led to the recognition of four sub-species. These populations show no plumage distinctions and differ only in the mean of their measurements, the birds becoming progressively larger in higher latitudes. Incubation is shared by both sexes, which take alternate spells of about 48 hours, and hatching takes place in about six weeks. Thermograph records of the temperature within a burrow during incubation and the growth of the nestling show great steadiness, independent of the variations of the outside atmosphere. Mortality of chicks is high, about 65 per cent succumbing, most often on account of starvation due to the blocking of the burrows by snow. The migrations of Wilson's petrel are among the longest known, for these Antarctic-born birds visit the British Isles and Newfoundland, the Red Sea and Persian Gulf, New Guinea and Northern Peru; and yet ringing of individuals has shown that they return each year to the same mate and the same burrow in the Antarctic. During migration between May and October a complete moult of plumage takes place. Many other matters of interest are dealt with in this valuable monograph.

Scenic Aspects of the Weather

WE are indebted to Mr. L. C. W. Bonacina for an illuminating essay upon a difficult subject written at a time when researches in pure knowledge are of necessity few ("The Place of Scenery in the Study of the Weather and Climate". By L. C. W. Bonacina. *Q. J. Roy. Met. Soc.*, **64**, No. 287, October 1940). It must not, however, be supposed that this class of work—and especially examples which have to do with feeling as well as thought—are unimportant at the present moment. On the contrary, it is very

desirable that contemplative intercourse with Nature should be cultivated during the exasperating experiences of war. Moreover, when we look ahead to the years that will follow the cessation of the present conflict, we see with certainty that the financial restrictions of the times to come can be countered to a considerable extent by concentration on those refined pleasures of the mind and senses which the æsthetics of scenery provide. The present paper is important for its treatment of scenery as a subject in which all the senses (not only the sense of sight) are concerned; and also for the detailed description of particular incidents in which the author observed those charms which landscape owes to certain transient, but recurrent, aspects of the weather.

Electrical Development in Iraq

THE series of articles dealing with various export markets of the world appearing in the *Electrician* includes one dealing with electrical development in Iraq (*Electrician*, December 6). For the last twenty years this has been mainly concerned with the provision of small generating plants designed to supply power and light to firms and for highways. Until seven years ago there was no sign of any intensive activity, but from 1933, development has taken place in Bagdad, Basra and Mosul. For all intents and purposes, Bagdad is the trading centre of the country, but since the extension of the Turco-Syria railways to the Iraqi frontier at Tel-Kotchek, Mosul is tending to develop an independent commercial life of its own. Incidentally, this extension of the railway, in late 1936, is playing a most useful part in the development of a hitherto minor market. At the moment, however, this line is not completed, so that it is not yet necessary for travelling agents to visit Mosul, nor is it necessary to appoint separate agents for this district. It is possible, none the less, that both these steps will have to be taken as soon as the railway is in full operation.

The growth of electricity in Iraq is reflected in the trade returns for electrical machinery and apparatus. For 1935 the total value of imports under this head was £141,846; in 1936 they showed a value of £198,391, and in 1937 a slight drop to £189,972. The figures for 1938 rose again to produce a total of £242,322. Of these figures Germany supplied £11,495 in 1935, £17,294 in 1936, £25,683 in 1937, and £31,795 in 1938. The shares falling to United Kingdom manufacturers over the same period were £103,289, £132,918, £106,525 and £130,859 respectively. Competition has been particularly strong from Germany in the case of heavy oil engines as the prime movers for generating sets. Here Germany had increased the lead she had gained in the years 1936–38. Analysing the figures shows that in dynamos and motors the supply is mainly from the United Kingdom. In 1937 imports in this class were valued at: United Kingdom £15,199, and Germany £4,218. The battery and accumulator market is shared fairly evenly between the United States and Great Britain. During 1937, imports valued at more than £6000 were supplied by both the United States of America and Great Britain. Imports of electric cables were valued at £25,872, and of this the United Kingdom supplied a total value of £19,584. As regards the development of the country, it is important to note that fuel oil is sold at a very cheap rate, about 2*d*. per gallon, and naturally this is the main source of power. With the exception of turbo-alternator sets in Bagdad, the prime movers for generating sets are oil-burning engines.

War-Time Building

THE design and erection of a war-time building present a number of problems which do not arise in times of peace. These are dealt with in *War-time Building Bulletin* No. 10, just issued by the Department of Scientific and Industrial Research (H.M. Stationery Office. 1*s*.). Since a building erected in war-time is presumably important in the war effort, the following factors over-ride almost every other consideration: (*a*) concealment from the air; (*b*) the minimizing of damage due to aerial bombardment; and (*c*) economy in the use of materials. The bulletin explains, in one document, how to begin tackling these problems.

Olinthus Gilbert Gregory, F.R.S. (1774–1841)

ON February 2 the centenary occurred of the death of Olinthus Gilbert Gregory, who for many years held the chair of mathematics at the Royal Military Academy, Woolwich, and was one of the promoters of the University of London, now University College. He was born on January 29, 1774, at Yaxley, Huntingdonshire, and he owed his first knowledge of mathematics to the Leicestershire botanist and agricultural writer, Richard Weston. At the age of nineteen he published a volume of "Lessons Astronomical and Philosophical", and about the same time, like many of his contemporaries, contributed to the "Ladies' Diary", an almanac and serial collection of mathematical papers, commenced in 1704 by John Tipper, and, like all almanacs, published by the Stationers' Company. His writings brought him to the notice of Charles Hutton, the professor of mathematics at Woolwich, and after a few years spent in teaching, bookselling, and newspaper editing at Cambridge, in 1802 he became a master at the Royal Military Academy, and five years later, on Hutton's retirement, he was made professor, holding his chair for thirty-one years.

Gregory was known as an excellent teacher, and he wrote works on astronomy, mechanics, and trigonometry, translated Haüy's "Natural Philosophy", and from 1802 until 1819 edited the "Gentleman's Diary"—founded in 1741—and the "Ladies' Diary" from 1819 until 1840. In 1823 he experimentally determined the velocity of sound. When, in 1827, the foundation stone of the University of London was laid, his was one of the names inscribed on it. His son, Sir Charles Hutton Gregory (1817–98), a distinguished railway engineer, in 1867 served as president of the Institution of Civil Engineers.

The Royal Military Academy

APART from the universities and Gresham College, the Royal Military Academy is perhaps the oldest of our institutions, with a long line of notable mathematicians. Woolwich became a naval station as long ago as the time of Henry VIII, and in the reign of Charles II a military depot was established there. In 1741, two hundred years ago, the Academy was founded for the education of cadets, with the German mathematician, John Muller (1699–1784), as headmaster. Two years later, Thomas Simpson (1710–61), who had taught mathematics while working as a weaver in Spitalfields and had published a work on fluxions, was made the professor of mathematics, holding that position until his death. He was a fellow of the Royal Society and a member of the Academy of Sciences, Stockholm. Like Gregory, he edited the "Ladies' Diary", as also did Charles Hutton (1737–1823), the self-taught Newcastle schoolmaster who was appointed to the mathematical chair in 1773. Hutton published many valuable works, and became Copley medallist and foreign secretary of the Royal Society. During the professorships of Hutton and Gregory the staff included for longer or shorter periods John Bonnycastle (1750?–1824), the Rev. Lewis Evans (1755–1827), and his son, Thomas Simpson Evans (1777–1818), and Peter Barlow (1776–1862), who from an obscure mercantile situation raised himself to the front rank of physical investigators. Since the days of these worthies of the eighteenth and early nineteenth centuries, the Royal Military Academy has had among its professors of mathematics many distinguished men, including Samuel Hunter Christie and Sir George Greenhill.

Alexis-Marie Rochon (1741–1817)

AMONG the less well known of the remarkable group of French men of science who lived through the Revolutionary period was Alexis-Marie Rochon, astronomer, physicist and mechanician, who was born at Brest on February 21, 1741, and died on April 5, 1817. Three years before his death, in August 1814, when Napoleon was an exile in Elba and Wellington was the British ambassador in Paris, Brewster, then aged thirty-two, visited Rochon in Paris, and in his diary for August 22 recorded, "I went this morning to call upon M. Rochon. . . a venerable and intelligent old man of seventy-three, who is well known to philosophers by his scientific works and inventions. He showed me his prismatic micrometer, a small instrument, with a level for measuring the inclination of lines to the horizon by the coincidence of two images, and his method of doubling the double refraction of Iceland crystal by extinguishing two of the images and employing two that are most remote. . . ."

Brewster and Rochon had much to talk about in optics, but optics was only one of the subjects to which Rochon had made contributions. He had been astronomer-optician to the Marine, had made voyages to Morocco and the Indian Ocean, at Brest he had been librarian to the Royal Marine Academy, keeper of a cabinet of philosophical instruments, the head of a workshop and the first director of the observatory founded at his suggestion. He had made improvements in telescopes, in the wire gauze used in ships' lanterns, and had written on the distillation of sea-water and many other subjects. A member of the old Royal Academy of Sciences, suppressed in 1793, he had been given a seat in 1795 in the newly founded National Institute, and had had a share in the introduction of the new weights and measures, and coinage. When after a long and useful career he died, his seat in the Institute passed to Fourier, and his *éloge* was pronounced by Delambre.

Announcements

SIR ARTHUR KEITH has been elected an honorary member of the New York Academy of Sciences.

DR. A. B. WALKOM, secretary of the Linnean Society of New South Wales, has been appointed director of the Australian Museum.

CANADA is setting up a blood "bank" to provide transfusions for 20,000 military and civilian casualties.

THE New South Wales Health Department proposes to appeal for at least 10,000 residents of both sexes between the ages of eighteen and sixty to participate in a blood-transfusion scheme to provide a twenty-four-hour service of blood donors to hospitals and doctors and a supply of blood for transfusions in any emergency.

ACCORDING to the Director of the Census, the population of the United States has increased by 8,634,835 since ten years ago, and is now 131,409,881. This increase is the smallest for any decade since 1790 when the first census was taken. It represents a 7 per cent increase in the population as compared with one of 16·1 per cent between 1920 and 1930, and one of 14·9 per cent between 1910 and 1920. The reasons given for this falling off are (1) a decline in the birth-rate and (2) the virtual stoppage of immigration.

THE following appointments in the Colonial Service have recently been made: J. Gordon, assistant conservator of forests, Gold Coast; R. G. Morgan, assistant conservator of forests, Gold Coast; T. I. Rees, assistant conservator of forests, Nigeria; Dr. H. F. Birch, assistant agricultural chemist, Jamaica; M. Park (plant pathologist), divisional and research staff officer, Ceylon.

IN NATURE of February 1, p. 144, the *Athenæum* was mentioned with the *Gardeners' Chronicle* and *Punch* as having been founded in 1841. This is incorrect. The *Athenæum* was founded in 1828, and Wentworth Dilke, one of the group concerned with establishing the other two journals, was editor during the period 1830–46.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Cultural Significance of Science

IN a communication printed in NATURE of January 25, p. 119, Prof. Polanyi takes issue with an earlier leading article[1] which had urged the rejection of the view that "science is set apart from all other social interests as if it possessed a peculiar holiness". A peculiar holiness, he maintained, is exactly what science does possess. The issue has the appearance of being a fundamental one, since it goes to the root of the whole relation between science and the social order, and some measure of agreement about the nature of this relationship is widely considered to be an urgent need. It may therefore be worth while to point out that this particular example of disagreement seems to be based on a purely verbal ambiguity. In the editorial, "holiness" meant, surely, "having an esoteric character", whereas to Prof. Polanyi it clearly meant "having overwhelming ethical value". I, for one, and there are certainly many like me, would not agree for a moment to deny the ethical value of the scientific method; but also do not feel quite confident against the accusation that it has in the main been applied to an unduly narrow range of phenomena. Have we too often exerted ourselves to take an unbiased view of something which is so recondite that there is no adequate reason why the ordinary man should have any view of it, biased or not?

"Scientific detachment", writes Prof. Polanyi, "is of the same character as the independence of the witness, of the jury, of the judge". But the witness, the jury and the judge turn their attention to problems presented to them as being socially important; they are not at liberty to choose to spend the afternoon discussing the sexual habits of Polynesian worms, or whatever else takes their fancy. The Editors of NATURE were, as I understood them, inviting us to spend more time investigating subjects as banal but relevant as crimes. Doubtless it is not altogether easy to preserve scientific detachment in such matters; and one can expect that what are generically termed "powerful interests" will attempt to influence scientific statements on matters of social consequence. But Prof. Polanyi's pessimistic assumption that such influences must always be successful in their nefarious work is vitiated by his own example of the persistence of a real and active legal detachment through many centuries of close contact with the turbulent forces of history.

It may be urged that the law, although employing the method of impartiality, is in its content merely the embodiment of the interests of the most powerful social group, and in that most important respect unfree; and it can be argued that a socially directed science, although free to be critical and objective, would have its attention fixed down to problems chosen for it by social forces outside its own control. But speaking as an embryologist of no cash value to anybody, addressing a physical chemist of enormous industrial importance, I should like to ask Prof. Polanyi if something of the sort is not true already. Our civilization is, to some degree, a society and not a mere collection of individuals. Men of science are, again to some degree only, involved in the social bonds which create the coherence of society. One could only be justified in calling for a less degree of involvement in those bonds if one disapproved of the society as a whole; if, for example, one was a revolutionary who wished to stay outside it so as to overthrow it.

C. H. WADDINGTON.

Christ's College,
Cambridge.
Feb. 1.

[1] NATURE, **146**, 815 (1940).

Science and Government

THE recent communication by R. H. F. Finlay[1] represents a point of view which seems to have some currency at the present time: the right of 'science' to govern. Is not this a threat to freedom? Since the foundation of science is the confession of truth, should we not admit that divided counsels are the breath of science; that not 'certainties' but hypotheses and theories form the stuff of science; that the conclusions of science are no more than provisional opinions based on evidence; that men of science have the virtues and vices of the politicians, trades unionists, lawyers, business men, peers and prelates through whom we govern ourselves to-day; that the omniscience proper to the law and so to government is foreign to science; and that the part of science in the government (a part for which there is unbounded scope) is the provision of knowledge? For if 'science' assume authority, and the current beliefs of science have the force of law, freedom of opinion must perish and truth be shackled indeed.

V. B. WIGGLESWORTH.

Hedgeside,
Beaconsfield.
Jan. 31.

[1] NATURE, **147**, 119 (1941).

The Walden Inversion in the Replacement of Hydroxyl by Halogen

THE first serious study of the steric course of this replacement was that of Frankland[1], who concluded that phosphorus pentachloride always substitutes with inversion of configuration, whilst thionyl chloride does so except when a phenyl group is attached to the seat of substitution. Although this

inference represented a remarkable advance, it is not quite correct, and also requires to be generalized. We have established that all the common substituting agents (PCl_5, $SOCl_2$, HCl, PBr_3, etc.) produce inversion unless a sufficiently powerful assembly, critical for each reagent, of electron-releasing groups at the seat of substitution reverses this result. For example, such an assembly, effective for all the reagents named, is present in the alcohols $CHPhBu^{\alpha}.OH$ and $CHPhBu^{i\alpha}.OH$. (We have carried out an improved resolution of the former and a new resolution of the latter.)

Kenyon, Lipscomb and Phillips first noticed[2] that in structures in which thionyl chloride ordinarily substitutes with retention of stereochemical form, it will substitute with inversion in the presence of sufficient pyridine. This is likewise a special form of a more general result, and we have in fact generalized it to include other substituting agents. For example, it applies to the action of phosphorus pentachloride on the two alcohols mentioned above.

Kenyon and Phillips attributed their phenomenon to the liberation of chloride ions[3], and, leaving aside details which Balfe and Kenyon have since explicitly modified[4], there is no doubt that they were right in their conclusion. However, because Gerrard[5] has cast doubt on their interpretation by emphasizing complications which we should not expect it to cover, we desire to direct attention to a recent general discussion of the problem, and to new observations on an aspect of it which is apparently in opposition, and is actually, in a certain sense, complementary to that illustrated in the phenomenon of Kenyon and Phillips.

In our discussion[6] we assumed that the first step in these substitutions is the formation of a condensation product or 'complex' such as $\geqslant$ C.O.SO.Cl, which can either eliminate the halide ion afterwards responsible for bimolecular or unimolecular substitution (S_N2 or S_N1), or, given a sufficiently facile electron-release from carbon to oxygen, can eliminate an oxide, thereby effecting an internal substitution (S_Ni); known principles determine how the stereochemical result depends on the mechanism followed :

$$\geqslant C\overset{O}{\diagdown}\underset{Cl}{\diagup}SO \rightarrow \geqslant C\text{–}Cl + SO_2 \text{ (retention) . . . . } (S_Ni)$$

$$\geqslant C.\overset{+}{O}SO + Cl^- \rightarrow Cl\text{–}C \leqslant + SO_2 \text{ (inversion) . . . . } (S_N2)$$

$$\geqslant \overset{+}{C} + SO_2 + Cl^- \rightarrow Cl\text{–}C \leqslant + SO_2 \text{ (predominating inversion) . . . . } (S_N1)$$

The effect of pyridine is explained as a competition of the type S_Ni *versus* S_N2; although the entity substituted in the S_N2-process, which the pyridine promotes, might be $R.OSO\overset{+}{P}y$ or $R.OSOCl$ rather than $R.OSO^+$, and analogously for other complexes. Thus halide ions produced by decomposition with a base promote substitution with an inversion of configuration.

But now, in the absence of a base, and in the presence of a good solvent for carbonium ions, we ought to be able to set up the alternative competition S_Ni *versus* S_N1. Let us consider the effect of chloride ions in this case.

With this object we refer to a recent demonstration[7] that reactions dependent on a preliminary rate-controlling ionization can with certainty be diagnosed when it is possible to observe that the anion produced, by participating in a reversal of the ionization, depresses the rate of the measured reaction. Applying this principle to the present problem, we see that, provided the ionization of the complex is rate-controlling, chloride ions, by reversing this ionization, can favour reaction S_Ni, and thus promote substitution with a retention of configuration.

Using several alcohols of the correct structural type and various substituting agents, we have set up the contemplated conditions by operating in liquid sulphur dioxide, chloride ions being supplied in the form of either triphenylmethyl chloride (a strong electrolyte) or tetraethylammonium chloride : the predicted effect has been observed repeatedly. For example, the alcohol $CHPhBu^{\alpha}.OH$ and phosphorus pentachloride in sulphur dioxide gave $CHPhBu^{\alpha}Cl$ with a rotation + 16·5°, whilst a comparative experiment in the presence of only 0·012 *M*-triphenylmethyl chloride yielded $CHPhBu^{\alpha}Cl$ of rotation + 87·7°; the positive sign of $\alpha_D^{20°}$ ($l = 1$) corresponds to a retention of configuration.

Comparing this effect with that produced by bases, one understands that chloride ions may quite reasonably do opposite things in different circumstances, and this emphasizes the danger of discussing such phenomena from too limited a viewpoint. Our full results will be published later.

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Aberystwyth.
Jan. 24.

[1] *J. Chem. Soc.*, **103**, 725 (1913).
[2] *ibid.*, 415 (1930).
[3] Cf. *ibid.*, 382 (1931).
[4] *ibid.*, 463 (1940).
[5] *ibid.*, 218 (1940).
[6] Cowdrey, Hughes, Ingold, Masterman and Scott, *ibid.*, 1252 (1937).
[7] Bateman, Church, Hughes, Ingold and Taher, *ibid.*, 961 *et seq.* (1940).

Viscosities of Three Classes of Liquids

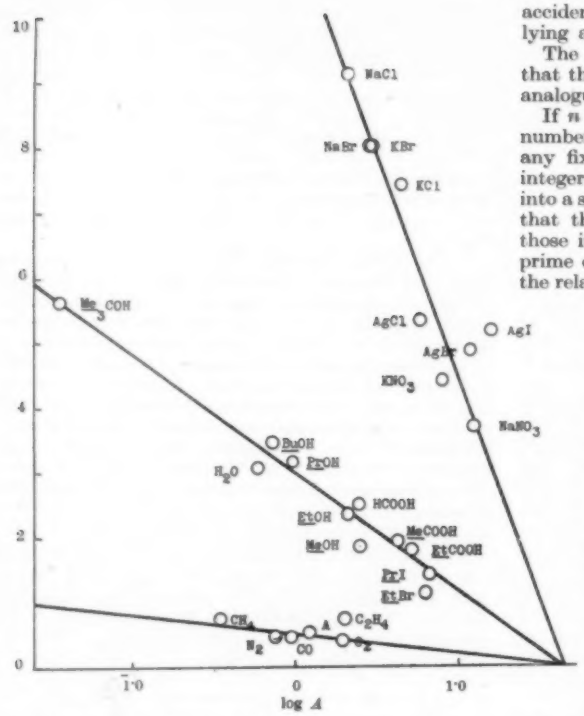
THE variation of the viscosity of a great number of liquids can be expressed by Guzmán's equation[1]

$$\eta = A\, e^{B/RT}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The values of the constants A and B for many liquids have been given by Ward[2]. It is now found that an approximately linear relationship holds between the values of B and $\log A$ (Fig. 1). Ionic liquids, hydroxylic liquids, and non-polar liquids have representative points close to three separate straight lines which appear to have a common origin (1·65, 0) on the $\log A$ *versus* B graph. Hence

$$B \cong m(1{\cdot}65 - \log A), \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where m is a different constant for each of the three classes of liquid. The graph points for the four alphyl halides cited by Ward (*loc. cit.*) lie just below the line



for the hydroxylic liquids; two of these points are shown in the graph. The data given by Ward for metallic liquids do not follow equation (2).

Since B is an energy term which corresponds roughly to the latent heat of fusion, equation (2) recalls the energy and entropy relationships found for other properties of liquids[3].

GEORGE NOVELLO COPLEY.

85 Christopher Way,
Liverpool, 16.
Jan. 3.

[1] *Anal. Fis. Quím.*, **11**, 353 (1913).
[2] *Trans. Farad. Soc.*, **33**, 88 (1937).
[3] Latimer and Buffington, *J. Amer. Chem. Soc.*, **48**, 2297 (1926). Latimer, *Chem. Rev.*, **18**, 348 (1936). Evans and Polanyi, *Trans. Farad. Soc.*, **32**, 1333 (1936). Butler and Reid, *J. Chem. Soc.*, 1171 (1936). Bell, *Trans. Farad. Soc.*, **33**, 496 (1937). Barclay and Butler, *Trans. Farad. Soc.*, **34**, 1445 (1938). Campbell and Eley, *Trans. Farad. Soc.*, **36**, 854 (1940).

Statistics and Prime Numbers

EINSTEIN'S statistical theory of Brownian motion has two aspects, one dealing with distribution in time, the other with distribution in space. It is known[1] that, while the spatial distribution is described, as in the chronology of a Geiger counter, by Poisson's enumerating law of independent rare events, the temporal distribution turns out to be determined by the classical theory of independent frequent errors. Precisely in view of the latter theory, and in view of the ergodic hypothesis, the spatial distribution requires a more specific model than does the temporal distribution; the former dealing with accidental fluctuations, the latter only with the underlying average state.

The object of this note is to point out the fact that this ambivalence in distribution has a complete analogue in the theory of prime numbers.

If n is a positive integer, let $\nu = \nu(n)$ denote the number of its distinct prime divisors, where m is any fixed positive integer or zero. If all positive integers which exceed unity are thought of as parcelled into a sequence of 'urns' $U_0, U_1, \ldots$ in such a way that the urn U_m contains the infinite sequence of those integers which possess exactly $m+1$ distinct prime divisors, then the ratio $\pi_m(n) : (n-1)$ supplies the relative frequency ('probability') of those integers which are in the m-th urn and do not exceed n; while $\nu(n)$ represents only a single cross-section of this infinite sequence of information.

The result corresponding to the normal distribution law in the theory of Brownian motion is represented by the following limit statement, which goes back to Hardy and Ramanujan and was recently proved in its sharper form by Erdős and Kac[2]: *If the deviation is measured on the scale of* $(\lg \lg n)^{1/2}$, *the distribution of the deviation of* $\lg \lg n$ *from the arithmetical mean of the values attained by the function* ν *of* n *on the range up to* n *tends to the symmetrical normal distribution of unit standard deviation, as* n *increases indefinitely.*

In view of the apparent parallelism between the average Brownian state and its accidental fluctuations on one hand and the single function $\nu(n)$ and the sequence of functions $\pi_0(n), \pi_1(n), \pi_2(n), \ldots$ on the other hand, the answer to the delicate problem concerning the distribution over the various urns $U_0, U_1, U_2, \ldots$ instead of the average distribution of their 'cross-section', will be expected to run as follows: *The positive integers not exceeding* n *are distributed over the various urns* $U_0, U_1, U_2, \ldots$ *in such a way that, in accordance with the law of independent rare events, the distribution is asymptotically represented by the Poissonian law of standard deviation* $(\lg \lg n)^{1/2}$, *if* n *increases indefinitely.* It will now be shown that this statement is correct, and that it is, as a matter of fact, a mere restatement of the prime number theorem.

A distribution over a sequence of discrete 'events' is called Poissonian if there exists a positive number λ such that the probability of the realization of the m-th event is proportional to $\lambda^m/m!$, where m varies through all positive integers and zero. Clearly, the factor of proportionality is $e^{-\lambda}$. The standard deviation is known to be $\lambda^{1/2}$. If the m-th event is represented by the presence of a positive integer in the m-th urn, U_m, where the positive integer is chosen at random among all positive integers not exceeding unity, then the relative frequency of the m-th event is $\pi_m(n) : (n-1)$, provided that the positive integer is restricted to be not greater than n.

Accordingly, the statement is that this relative frequency becomes asymptotically proportional to the Poissonian probability $e^{-\lambda}\lambda^m/m!$, where the standard deviation, $\lambda^{1/2}$, is stated to be $(\lg \lg n)^{1/2}$, while m is arbitrarily fixed. In other words, what has to be verified is that if m is arbitrarily fixed, $\pi_m(n)$ is asymptotically proportional to $n(\lg n)^{-m}/n!$. But it is shown by a well-known elementary calculation, which was apparently first carried out by Gauss[3], that if this asymptotic proportion is true for

the particular index $m = 0$, then it is true for every fixed m. Since the asymptotic proportion reduces for $m = 0$ to the prime number theorem[4], the proof is complete.

AUREL WINTNER.

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Baltimore.
Dec. 23.

[1] Cf., for example, Borel, E., and Delthell, R., "Probabilities-Erreurs" (Collection Armand Colin, No. 34, art. 67 and art. 66; 1934).
[2] Erdös, P., and Kac, M., "The Gaussian Law of Errors in the Theory of Additive Number Theoretic Functions", *Amer. J. Math.*, **62**, 738-741 (1940).
[3] Gauss, C. F., "Werke", **101**, 11 (1917).
[4] Cf. Ingham, A. E., "Distribution of Prime Numbers". (Cambridge Tracts in Mathematics and Mathematical Physics, No. 30.)

Rust-Resistant Wheats for Egypt

OUR results resemble those obtained by Mehta and Pal[1] in India so closely that we are prompted to report them here.

All three rusts of wheat occur in Egypt, but the greatest loss in yield is caused by black rust on *vulgare* wheats in the Delta; our data indicate that the average annual loss is not less than 10 per cent of the possible yield, or about 2½ million bushels. The barberry plays no part here in the annual recurrence of black rust, for it is not found in or near Egypt, and wheat plants are so rarely found in summer that it is unlikely that they carry over the rust. Air-borne spores of black rust have, however, been found coming from the north-west[2] and it may be that this is the main source of infection.

Indian *vulgares* are better suited to Egyptian conditions than any other imported wheats (with the exception of one Italian variety Mentana), and Egyptian *vulgares*, known as Hindi wheats, are of Indian origin. Hindi and Indian wheats have all been found to be highly susceptible to black rust in Egypt, and interspecific crossing was thus resorted to in an attempt to obtain a resistant *vulgare*. We have produced a moderately resistant *vulgare* variety Mabrook from Giza 7 (*vulgare*) × Beladi 42 (*pyramidale*) which gives about 17 per cent higher yield than Hindis in the Delta, mainly because of its increased seed size and weight.

A large number of imported varieties have been tested for their resistance to black rust in Egypt, and as was the case in India we have found some *vulgares* with a promising degree of resistance in a group of Kenya wheats kindly supplied by the Director of Agriculture, Kenya, and by the Director of Plant Breeding, Department of Agriculture, New South Wales, Australia. Under Egyptian conditions these varieties are poor yielders and, according to our requirements, have other undesirable characters.

Since 1936 we have been crossing them with Egyptian wheats and we have obtained some F_4 and F_5 lines which are very resistant, give high yields and possess other desirable characters. *UX9M1A3* (Kenya) crossed with Giza 7 has given lines which are more resistant than the parents and in fact are almost completely resistant. Giza 7, from Federation × Indian 7, is less susceptible than Hindis and is our best quality Egyptian wheat. The Kenya parent shows quite a high degree of resistance, and we are informed that it is of unknown hybrid origin. We find that it has a gene for waxless foliage which is the dominant allelomorph of a gene for waxy, whereas waxy is usually dominant to waxless in *vulgare*. This indicates that it may have arisen from an interspecific cross, obtaining the dominant waxless and its rust resistance from the tetraploid parent.

The physiological races of black rust in Egypt have not been determined, but the above evidence suggests that they may be the same as those found in India.

The discovery of resistant *vulgares* has simplified our problem, and it appears that already we have made good progress towards the production of a resistant variety which is suited to Egyptian conditions and requirements.

JAMES PHILP.
A. G. SELIM.

Plant Breeding Section,
Ministry of Agriculture,
Giza.
Dec. 1.

[1] Mehta, K. C., and Pal, B. P., NATURE, **146**, 98 (1940).
[2] Jones, G. H., Bull. No. 146, Egyptian Min. of Agric. (1935).

Riboflavin in Black Pepper

Fixen and Roscoe[1] quoting Murthy[2] place the fresh green berries of *Piper nigrum* extraordinarily high in the list of riboflavin-containing materials. Commercial black pepper, which consists of the dried berries of this plant also picked in the green stage, was considered as a possible source of riboflavin. When this product was assayed for riboflavin by the method of one of us[3] it was found to be devoid of riboflavin. An aqueous extract gave a very strong green fluorescence at high dilutions, but the solubility properties of the fluorescent material were not those of riboflavin but were similar to those of piperine. That this is the substance in black pepper which is responsible for the observed green fluorescence is confirmed by the strong fluorescence obtained with purchased piperine at a dilution in water of 1 in 2 million. Piperine in alcohol solution gives a light blue fluorescence with ultra-violet light, and in chloroform a purple blue fluorescence is seen. The fluorescent material in black pepper behaves in a similar manner to piperine, whilst riboflavin gives a green fluorescence in both water and alcohol, and luminoflavin fluoresces green in alcohol, chloroform or water solutions.

Murthy uses an isolation method based on adsorption on fullers' earth, and admits the desirability of confirming the high value which he obtained for pepper by animal tests. We are of the opinion that when dealing with material of unknown fluorescent behaviour it is advisable to define riboflavin as a substance with a green fluorescence which is insoluble in chloroform and which after exposure to ultra-violet light in $N/2$ sodium hydroxide becomes chloroform-soluble without loss of fluorescence.

G. E. SHAW.
H. G. HIND.

Evans Biological Institute,
Runcorn,
Cheshire.
Jan. 16.

[1] Fixen and Roscoe, *Nut. Abs. & Rev.*, **9**, 795 (1940).
[2] Murthy, *Ind. J. Med. Res.*, **24**, 1083 (1937).
[3] Shaw, *Quart. J. Pharmacol.*, **12**, 541 (1939).

RESEARCH ITEMS

Upward Movement of Soil Solutes in Plants

THERE is now satisfactory evidence that solutes can move up the wood alone in amounts approximating those moving in intact stems, but the evidence concerning movement in bark is scarcely so satisfactory. A re-examination of this latter point has recently been made by Mason and Phillis (*Ann. Bot.*, N.S. **4**, 765; 1940). Sea Island cotton plants are approach grafted and the weaker top removed, leaving a plant with one top and two root systems, one the 'main' root and one the 'side' root. The plants are grown under conditions of nitrogen starvation up to the time of the experiment, when the main root is immersed in solutions richer in nitrogen and the side root in a calcium sulphate solution. In one set of plants a half-inch ring of phloem is removed between the fork and the side root, and a half-inch segment of wood from between the fork and the main root. In a second set ('normal') the stem between the fork and the side root is severed. Both sets therefore receive adequate water, and nitrogen is absorbed only by the main root. All plants are harvested after five days and analysed for nitrogen and for bromine, which was also added to the culture solution bathing the main roots. Both sets are compared with an initial collection. Increase in both nitrogen and bromine is found to be significant in the plant as a whole and in the tops, for both 'normal' plants and 'cut wood' plants. Uptake was, however, considerably diminished in the latter group. Only traces of bromide entered these plants, so that this ion must travel with difficulty in phloem. With nitrogen, although translocation to the top was considerably diminished in amount by the wood 'ring', about the same *proportion* of the nitrogen absorbed by the plant reached the tops as in normal plants. Nitrogen therefore passes up the bark alone at a rate approximating that in bark plus wood. Previous work has shown the same statement to be true also for wood alone. It is impossible to say which channel is most used by normal intact plants.

Structure of the Apple Cortex

W. H. SMITH (*J. Pom. and Hort. Sci.*, **18**, 249; 1940) has investigated the relations between the size of a mature apple, size and number of cells in the fleshy tissues, its level of respiratory activity and its keeping quality. It is concluded that the histological structure of the cortex of different varieties is related to their physiological behaviour. Apples with a longer growing season were found to have a smaller number of constituent cells in unit weight of tissue and a greater degree of cell enlargement, associated with relatively low respiration rate and good keeping quality. In short-season varieties there was a larger number of smaller cells, high respiratory activity and more rapid rate of senescence. The amount of cell multiplication varied with variety and largely determined typical fruit size. Within a variety, average cell size was correlated with the weight of the mature fruit, larger apples having larger cells. The number of cells was also greater in larger apples than in smaller ones of the same variety. Fruit size at maturity was thus determined both by amount of cell multiplication and degree of cell enlargement.

Nodule Bacteria and their Hosts

THE relative efficiency of nodule bacteria which attack leguminous plants has a very marked effect upon crop yield. Several factors appear to affect this efficiency, and H. K. Chen, Hugh Nicol and H. G. Thornton have recently investigated the part played by root juices of the host plant (*Proc. Roy. Soc.*, B, **129**, 475; 1940). Cultures of the nodule bacteria from soy bean and pea were treated with such juices obtained from plants with effective and with ineffective nodules. Extracts from roots with effective nodules produced a significant improvement in growth of the bacteria in a substantial number of the experiments. Juice from roots with ineffective nodules depressed the growth-rate of the bacterial cultures in several experiments, but the rate of increase of the different bacterial strains with root juice from uninoculated, nodule-free plants was not correlated with their effectiveness. It is evident that relations between the bacteria and their host are not always harmonious, and it is suggested that, as a result of infection, the plant produces soluble substances in its roots which, through their effect upon bacterial growth, can determine the relative efficiency of nitrogen fixation.

Pests of Garden Vegetables

G. FOX WILSON contributes a timely paper upon "Some Seasonal Pests of Garden Vegetables" to the *Journal of the Royal Horticultural Society* (65, Pt. 12; Dec. 1940). This reflects the author's flair for grouping pests according to their effects or their control, and is mainly written for growers of food. The economic entomologist will, however, find a little new documenting of his subject, such as a map showing relative distribution frequency of the cabbage white fly, *Aleurodes brassicæ*, in England and Wales, a photograph of a shaker blower for the application of nicotine dust, and a description of 'bloated' onions infected with the bulb eelworm, *Anguillulina dipsaci*.

Mutation Effects of Ultra-Violet Light

K. Mackenzie and H. J. Muller (*Proc. Roy. Soc.*, B, 1929, **691**; 1940) provide important data on the effects of ultra-violet light on *Drosophila melanogaster*. It is shown that the most effective wave-lengths for the production of gene mutants lie between 320 and 300 *mμ*, which correspond to those absorbed by nucleic acid. The incidence rate of gene mutants and structural alterations was studied in the same individual, and the authors' earlier results were confirmed that ultra-violet light, unlike X-rays, are ineffective in causing gross rearrangements in structure. Preliminary evidence indicates that minute alterations in structure are also rarely produced by ultra-violet light. This fact leads to important conclusions such as: (1) minute deletions and gene mutations are probably distinct; (2) activation of nucleic acid by radiation can give rise to gene mutation, but is ineffective in producing structural rearrangements; (3) the size of the gene may not be measured by ionization quanta since gene mutations occur secondarily as the result of a transfer of energy from nucleic acid as the primary effect. The atoms of the

gene itself are not ionized specifically and directly by the ultra-violet light. The authors suggest that the relationship, if any, between cancer and gene mutations and ultra-violet light might be investigated with advantage in the light of this knowledge.

The Cheviot Granite

THE results of a recent detailed study of the Cheviot granite by A. G. Jhingran were communicated to the Geological Society at the meeting of January 22. The granite occupies an area of 22 square miles, but owing to a thick covering of peat and drift exposures are poor. Three main types are recognized: (*a*) the marginal variety, fine-grained and dark, with abundant plagioclase; (*b*) the Standrop variety, forming the central part of the area, relatively coarse-grained and light, with dominant orthoclase and abundant quartz; (*c*) the granophyric variety, containing biotite, occupying the ground between the others. Types (*a*) and (*b*) are pyroxene (diopside and hypersthene) granites. They contain numerous fine-grained inclusions which are composed of the granitic minerals, but with larger proportions of biotite and pyroxene. Chemically, a typical example falls at the silica-poor end of the variation diagram of the granitic types. The lavas around and included within the granite have been metamorphosed; but they seem to have caused little modification of the granite, if any. The variability of the granite is nevertheless probably due to contamination, but by Silurian greywacke and shale. A process of simple differentiation seems to be inapplicable, and no field evidence suggesting emplacement by successive injections has been found.

Mica in Tanganyika

THE pegmatitic mica deposits of the Uluguru Mountains, first discovered by Stuhlman in 1894, were successfully worked by the Germans until hostilities began in 1914. Under the direction of a British Military Board the industry was restarted in 1917. In subsequent years much prospecting was carried out and other important sources of mica—mainly of muscovite—were discovered. In 1920 the Government disposed of the various claims and private individuals began to operate, peak production being reached in 1925. Since then the industry slowly dwindled until 1937, when a revival set in. There are ample resources to meet a wide range of demands, and in order to stimulate further developments a report on the subject has recently been issued which makes available full information as to the geology of the mica fields and the conditions and requirements concerning prospecting, mining, grading and preparation, and marketing (G. J. Williams and A. F. Skerl, Tanganyika Terr. Dept. Lands and Mines, *Geol. Div. Bull.*, Dar es Salaam, **14**, 47; 1940). The mica-pegmatites are restricted to rocks of the Lower Basement Complex, through which they are distributed fairly uniformly. It is noted that there is no spatial relationship between the pegmatites and either the older granites or the later central granite batholith of the Territory. This constitutes a serious objection to the traditional view that such pegmatites represent the residual fractions of granitic magmas. The authors favour the rheomorphic hypothesis and suggest that the pegmatites have been formed from palingenetic fluids, generated in depth, which may have migrated through a considerable vertical distance before deposition took place. Particulars are also given of lepidolite, in greisen-like pegmatite; phlogopite, associated with crystalline limestone or pyroxenite; fuchsite, a constituent of schists and quartzite; and vermiculite, associated with pegmatites cutting ultra-basic rocks.

Stability of Emulsions

EARLIER workers on emulsions regarded the interfacial electrical potential as an important factor in relation to the stability, but later work with protected emulsions indicated that the protective film of emulsifying agent conferred stability of the droplet in the emulsion; other recent workers believe that electrical conditions play a dominant part, but in some cases the emulsifying agents were liable to react with many of the electrolytes employed. A. King and G. W. Wrzeszinski (*J. Chem. Soc.*, 1513; 1940) have studied the influence of electrolytes on stabilized oil-in-water emulsions. No relation was observed between the electrical charge and emulsion stability in cases where chemical reactions were absent. The stability is ascribed to the properties of the film of emulsifying agent which surrounds each particle, which is generally strongly hydrophilic and, owing to hydration, is stable even at the isoelectric point. In the action of salts the effect of the anion is preponderant and is determined by its position in the lyotropic series. The destabilizing effect of any given salt on a particular emulsion is apparently due to the disruption of the absorbed film of stabilizing agent. There is nothing to differentiate between the stability of the film and of the emulsion. The concentration of the internal phase in the emulsion is also important in determining the stability in presence of electrolytes.

Internal Temperature of White Dwarf Stars

IN an important paper (*Astrophys. J.*, **92**, 321; 1940), R. E. Marshak investigates in detail the probable condition of matter in the cores of the white dwarfs Sirius *B* and 40 Eridani *B*, with the view of deciding how the radiation from such stars is maintained and how they are likely to evolve in the future. Energy transport is found to be chiefly by radiation in the non-degenerate envelope; but by electronic conduction in the degenerate core. The free-electron density and the pressure are calculated for the radiative envelope, for the core, and for the intervening transition region; and then the equations of stellar equilibrium are numerically integrated through the surface regions and on into the interior. For Sirius *B* the thickness of the non-degenerate envelope and the internal temperature are calculated for various assumptions regarding the chemical constitution of the star: the envelope is found to extend over only 6 per cent of the radius at most, while the central temperature is found to be about 15×10^6 degrees C. for a Russell mixture of elements. At this temperature reactions between protons and other nuclei would go on very rapidly, and since the luminosity is so low, a negligibly small upper limit is deduced for the concentration of hydrogen in the core. This is true whether the source of energy is the carbon cycle or the proton-proton reaction. It is therefore concluded that the transmutation of hydrogen cannot account for the observed production of energy; thermonuclear processes are abandoned as the main source of energy, and recourse is had to the old gravitational-contraction theory, which gives a lifetime of at least 10^8 years before the white dwarfs cease to radiate visibly.

TELECOMMUNICATIONS TECHNIQUE AND BROADCASTING RECEIVERS

TWO papers which would, in normal circumstances, have been presented at the December and January meetings of the Wireless Section of the Institution of Electrical Engineers are now available. The full papers will be published in the June issue of the *Proceedings* of the Wireless Section, while extended abstracts are contained in the January issue of Part I of the *Journal of the Institution*.

The first of these papers is entitled "The Application and Use of Quartz Crystals in Telecommunications" and its author is Mr. C. F. Booth, of the Radio Branch of the Post Office Engineering Department. The piezo-electric crystal has played a major part in the advances which have been realized in telecommunications during the past ten years, and without its aid many radio-frequency generation and selection problems could not have been solved. Of the several crystalline substances possessing the piezo-electric property, quartz, tourmaline and Rochelle salt have been used in various phases of communications technique. The British Post Office has been actively concerned for many years with both the application and production of the quartz oscillator and resonator, and Mr. Booth's paper presents an account of this work and directs attention to some of its more important applications.

For the production of electrical oscillations of very stable frequency, whether for laboratory purposes or for the control of radio transmitters, the quartz crystal oscillator provides the simplest solution when a specific frequency in the range 50–200,000 kc./s. of stability better than $\pm 100/10^6$ is required, and it is almost the only solution for stabilities better than $\pm 10/10^6$. The type of quartz oscillator now in use has a frequency-temperature coefficient of less than $\pm 2/10^6$ per degree centrigrade, and while the output power obtainable from such an oscillator is small, this may readily be amplified up to the highest powers required for radio transmitting purposes. Much of the success of the widespread use of radio communication rests upon the ability so provided of maintaining radio transmitters upon their allocated frequencies within narrow tolerances. For example, a feature of present-day broadcasting involves the operation of several transmitters on the same frequency. Such transmitters may not vary in frequency by more than 1 c./s., and such stability has only been obtained in practice by means of a quartz oscillator control. In addition to such applications, the quartz crystal element may be associated with suitable electrical circuits to provide radio-frequency filters of a very high selectivity.

The chief source of good natural quartz is Brazil, and the selection and testing of such raw material and the production therefrom of suitably cut crystals for radio purposes is a highly specialized art. The paper referred to above includes a well-illustrated section describing in some detail the methods employed in the crystal laboratory of the Post Office for the production, adjustment and testing of quartz oscillators and resonators for use by that department in its many and widespread activities in the field of telecommunications. It is visualized by the author that the quartz crystal will play an increasingly important part in the ever-growing technique of communications.

The second paper is entitled "Broadcast Receivers: a Review"; and its authors, Messrs. N. M. Rust, O. E. Keall, J. F. Ramsay, and K. R. Sturley, are members of the staff of Marconi's Wireless Telegraph Co., Ltd. This paper comprises a review of broadcast receiver circuits and developments over the ten-year period from 1929 up to the outbreak of war. The first part of the paper has been compiled from an examination of more than a thousand circuit diagrams, and is a review of such receiver circuits which have stood the test of production. The broadcasting receiver is analysed stage by stage in the paper with the aid of typical diagrams, in an attempt to extract the salient technical features. It would appear, however, that as the sales market over the period under consideration consisted mainly of purchasers of first receivers, the trend of design was influenced by selling points rather than basic principles and potential users' needs.

Recognizing the limitations referred to above, the second portion of this paper is concerned with some fundamental problems and the lines of possible future development. Selectivity, fidelity, electrical interference and automatic accessory circuits for volume, frequency, selectivity and remote control are some aspects of receiver design to which attention is devoted. Up to date, two specifications, which attempt to define and assess the performance of broadcasting receivers, have been produced; one was first published in 1930 by the Institute of Radio Engineers in the United States, and has since been modified and extended; the second was published in Great Britain in 1936 by the Radio Manufacturers' Association. Such specifications were, however, found to be inadequate, and when happier times return they will have to be drastically revised to meet the needs of the broadcasting receiver industry.

The concluding portion of this paper refers to the difficulties accompanying the allocation of wavelengths to broadcasting stations, and the prevailing congestion in the long and medium wave bands. With the view of meeting these difficulties, there has been a tendency to urge the advantages of broadcasting over telephone lines and electricity supply networks. The authors point out, however, that the position might be ameliorated to a considerable extent if the channel width utilized was related to the programme requirements. Thus, instead of using uniform channels of 9 kc./s. nominal width, it would be preferable to allot a single side-band channel of 5 kc./s. for speech, and a 20 kc./s. double side-band for programmes requiring high quality. In such cases, transmitter and receiver design would need to be correlated, and opportunities for exploring this possibility may occur in the future.

DEEP-FOCUS EARTHQUAKES OF THE SOUTH-WEST PACIFIC

R. C. HAYES, of the Dominion Observatory, Wellington, New Zealand, read a paper on deep-focus earthquakes of the south-west Pacific at the Sixth Pacific Science Congress in 1939.* The Dominion Observatory at Wellington has for many years carried out the determination of provisional epicentres in the region south of the equator, lying between long. 140° E. and long. 160° W. In the region investigated, it appears that about 11 per cent of all the earthquakes have abnormally deep foci, and that about 60 per cent of the deep ones occur between lat. 10° and lat. 30° S.

It is found that the deep-focus earthquakes occur in most parts of the general seismic belt extending south-eastward from near the coast of south-eastern Asia, through New Guinea, the Solomon Islands and the New Hebrides to the region of Fiji, Tonga and Samoa. The belt of both normal and deep earthquakes thence appears to turn southward toward New Zealand, although the deep earthquakes apparently become less frequent as the New Zealand region is approached. There is no evidence of a continuation of this belt across the South Pacific toward South America, but there is a short extension north-eastwards to Samoa.

The occurrence of deep-focus earthquakes near the Kermedec Islands and New Zealand has been confirmed. According to Hayes, the earthquakes of October 30 and November 1, 1938, with epicentres north-east of Taupo in the North Island, had focal depths of the order of 200 km. Present evidence indicates that the western Pacific deep-focus belt, after turning southward from the Fiji region toward New Zealand, probably terminates just east of New Zealand in about lat. 42° S., or at least is interrupted at this point for a distance of about 400 miles.

Wadati, Berlage and Davison have previously noticed that in Japan, Manila (East Indies) and South America respectively the depth distribution of deep-focus earthquakes appears to increase in the 'continental' direction. Hayes states that the data so far available do not show very clearly whether this type of distribution exists in the south-west Pacific except in the Fiji region, where depths are definitely greater on the 'continental' side of the earthquake belt than on the Pacific side.

An important feature which Hayes has observed in some deep-focus earthquakes in the south-western Pacific is the remarkably large amplitudes sometimes recorded at Wellington of the phases *ScS* and *sScS*. When these are both observed, they provide a comparatively accurate method of determining focal depth.

* *Bull.* S. 59, Dom. Observ. Wellington. Proc. Sixth. Pac. Sci. Congress, 1939.

FESTIVALS OF THE MIN CHIA, YUNNAN

RELIGIOUS festivals of the Min Chia, a non-Chinese tribe of Yunnan, have been described by C. P. Fitzgerald (*Man*, December 1940) to illustrate that their acceptance of Chinese culture, in so far as religious belief and practice are concerned, is less complete than outward appearance would indicate. While the Min Chia in fact are acquainted with a form of Buddhism, they worship a number of non-Buddhist deities and practise the rites of ancestor worship; but it is not correct to say that they have three religions. In practice the worship of the Buddhist Boddhisatvas and Taoist deities forms one religion served by the same rite—burning incense before the shrine—and attended by the same people, usually women and girls. It may be contrasted with ancestor-worship, in which women take a less active role, and which is a private family affair without public festivals or temples.

Of the ancestral ceremonies, one of the most elaborate is the Shu Bao or "burning the bundles", which takes place on the 15th day of the 7th lunar month (in 1937, August 19) for the purpose of dispersing the ancestral spirits after their annual sojourn of fourteen days in the home. It takes its name from the burning of bundles of 'books' of Chinese poems, on each of which is inscribed the name of an ancestor, to a total number of perhaps one hundred individuals, extending back to the tenth generation.

A festival characteristic of the worship of local deities is the Gwer Sa La, a dance festival held in the villages along the lake north of Ta Li on the 25th of the fourth lunar month (May) between the gathering of the wheat harvest and the transplanting of the rice seedlings. Young men dancers, arrayed in costumes in some ways suggesting those of women, pass through all the villages on the lake shore, dancing at each, singing and acting in a half-intoxicated manner, both they and the spectators behaving boisterously. The last dance is always in the Mer Ger Yu village, and after a feast the dancers disperse, before the last act of the festival in which the tablet of the ancestor of this village is carried in procession in a litter to a spot a mile distant at the edge of the village lands, where the arrival of the last body of dancers is awaited. All return, the dancers dancing continuously, to the village, and after a final dance the tablet is returned to the temple and a feast follows.

The meaning of the rite is obscure, though it is said to be intended to bring benefit to the rice crop. The dancing at this feast is identical with the performance of a class of exorcists known as *sai daer*, which may mean "westerners".

FORTHCOMING EVENTS

Tuesday, February 18

INSTITUTION OF CIVIL ENGINEERS (Joint Meeting with the British section of the Société des Ingenieurs civils de France) (at Great George Street, London, S.W.1), at 1.30 p.m.—M. Tony Jules Gueritte: "Further Data concerning Pre-Stressed Concrete: Comparison between Calculated Stresses Registered during Tests".

Wednesday, February 19

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. Julius Grant: "Art and Science in Paper Manufacture".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. E. Greenly: "The Glacial Phenomena of Arron". Mr. B. C. King: "The Cnoc na Cuilean Area of the Ben Loyal Igneous Complex".

Friday, February 21

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, London, S.W.1).—Annual General Meeting. Lt.-Col. P. H. Johnson: "The Mechanical Requirements of the Royal National Lifeboat Institution".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TWO ASSISTANT LECTURERS IN MECHANICAL ENGINEERING at the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (February 21).

LECTURER IN MATHEMATICS AND SCIENCE at the Chesterfield Technical College—The Clerk to the Governors, Technical College, Infirmary Road, Chesterfield (February 22).

VICE-PRINCIPAL AT THE ARAB WOMEN'S TRAINING COLLEGE, Palestine—The Secretary (I.P.R.), Board of Education, Alexandra House, Kingsway, London, W.C.2 (February 24).

GRADUATE LECTURER IN MATHEMATICS AND PHYSICS at the Burnley Municipal College—The Director of Education, Education Offices, Burnley (February 24).

PRINCIPAL OF THE SHREWSBURY TECHNICAL COLLEGE—The Secretary for Education, Education Office, County Buildings, Shrewsbury (February 26).

DIRECTOR OF EDUCATION to the Isle of Wight County Council—The Clerk to the County Council, County Hall, Newport, Isle of Wight (February 26).

LECTURER-IN-CHARGE, DEPARTMENT OF COAL MINING, Technical Education Branch, Department of Public Instruction, and a LECTURER UPON COAL-MINING ENGINEERING, etc., University of Sydney—The Official Secretary, New South Wales Government Offices, 125 Strand, London, W.C.2 (February 28).

PRINCIPAL of the Salisbury Diocesan Training College for Women Teachers—The Hon. Secretary, Diocesan Training College for Women Teachers, The Close, Salisbury (March 1).

HEADMASTER of the County School for Boys, Beckenham and Penge—Mr. G. Crease, 12 Beckenham Road, Beckenham, Kent (March 8).

DEMONSTRATOR IN THE DEPARTMENTS OF CHEMISTRY AND PHARMACY—The Registrar, Portsmouth Municipal College, Portsmouth.

ASSISTANT ENGINEER by the Government of Dominica (British West Indies)—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9551).

ENGINEER for the Public Works Department of the Government of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9552).

ENGINEERING ASSISTANTS at the Air Ministry—London Supplementary Register Office, Ministry of Labour and National Service, 4 Great Marlborough Street, London, W.1 (quoting Order No. 472).

LECTURER IN MECHANICAL ENGINEERING and TWO LECTURERS IN ELECTRICAL SUBJECTS at the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ollscoil na h-Eireann (The National University of Ireland). Calendar for the Year 1939. Pp. ix+344+674+452. (Dublin: National University of Ireland.) [91

London Shellac Research Bureau. Technical Paper No. 19: Lac-Cellulose Lacquers. By Dr. B. S. Gidvani and Dr. R. Bhattacharya. Pp. 24. (London: London Shellac Research Bureau.) [91

University of London: University College. Calendar, Session 1940–1941. Pp. lxiv+576+lxv–lxxix. (London: Taylor and Francis, Ltd.) [91

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport). Annual Report and Results of Meteorological Observations for the Year 1939. By George A. Lidster. Pp. 32. (Southport: Fernley Observatory; London: Air Ministry.) [91

Institution of Gas Engineers. Publication No. 234: 1st Report of the Chairmen's Technical Committee, 1939–1940. Pp. 24. Publication No. 237: Second Arthur Duckham Research Fellowship Report—The Radiation from Solid Substances under Flame Impact. Part 1. By E. C. W. Smith. Pp. 36. (London: Institution of Gas Engineers.) [91

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 9: Oak Galls in the *Historia Plantarum* of Theophrastus. By Prof. Gustav Senn. Pp. 343–354+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). 2s. [91

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 801, Vol. 239: The Soft X-ray Spectroscopy of Solids. By H. W. B. Skinner. Pp. 95–134. 6s. 6d. Series B: Biological Sciences. No. 572, Vol. 230: The Flight of the Dipterous Fly *Muscina stabulans* Fallén. By F. S. J. Hollick. Pp. 357–390. 5s. No. 573, Vol. 230: The Devonian Fish *Palæospondylus gunni* Traquair. By J. A. Moy-Thomas. Pp. 391–414. 7s. (London: Cambridge University Press.) [91

Other Countries

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 39: Studies on the Preservation of Fruit Juices, 2: Experiments on the Preparation and Preservation of Unfermented Apple Juice. By Lal Singh and Dr. Girdhari Lal. Pp. 24. (Delhi: Manager of Publications.) 14 annas; 1s. 3d. [91

Government of Travancore. Administration Report of the Government Museum, 1114 M. E. Pp. ii+8. (Trivandrum: Government Press.) [91

Union of South Africa: Department of Agriculture and Forestry (Division of Chemical Services). Bulletin 213 (Chemistry Series No. 160): Survey of the Most Important Tobacco Soils of the Union of South Africa. By Dr. J. L. Steenkamp. Pp. 74. (Pretoria: Government Printer.) 6d. [91

Publications of the Observatory of the University of Michigan. Vol. 8, No. 2: Spectrophotometric Determinations of Stellar Temperatures, 4: An International Comparison of Standard Lamps. By Robley C. Williams. Pp. 37–44. (Ann Arbor, Mich.: University of Michigan.) [91

Report of the President and of the Treasurer for the Year ended September 30, 1940. Pp. 184. (New York: Carnegie Corporation of New York.) [91

Bulletin of the American Museum of Natural History. Vol. 77, Art. 8: The Post-Glacial History of *Zonotrichia capensis*. By Frank M. Chapman. Pp. 381–438. (New York: American Museum of Natural History.) [91

Publications of the University of Sydney, Department of Zoology. Monograph No. 1: The Plankton of the Australian Coastal Waters off New South Wales. Part 1: With special reference to the Seasonal Distribution, the Phyto-Plankton, and the Planktonic Crustacea, and in particular, the Copepoda and Crustacean Larvæ, together with an account of the more frequent members of the Groups Mysidacea, Euphausiacea, Amphipoda, Mollusca, Tunicata, Chaetognatha, and some reference to the Fish Eggs and Fish Larvæ. By Dr. William J. Dakin and Alan N. Colefax. Pp. 215+4 plates. (Sydney: University of Sydney.) 21s. [91

Catalogues, etc.

The *Industrial Chemist* Diary for 1941. Pp. 20+Diary. (London: The *Industrial Chemist*).

The Nivoc Supplement. Special War Issue No. 4, December 1940. Pp. 16. (London and Birmingham: W. and J. George, Ltd., proprietors of F. E. Becker and Co.)

Mathematics, Astronomy, Physics, from the Library of the late Prof. A. E. H. Love. (No. 89.) Pp. 40. (Oxford: Parker and Son, Ltd.)

College Diary, 1941. Pp. 32+Diary. (London: South-West Essex Technical College and School of Art.)

Calendar for 1941. (Newcastle-upon-Tyne: C. A. Parsons and Co., Ltd.)

The B.D.H. Vena-Flask and its use in Intravenous Therapy. Pp 20. (London: The British Drug Houses, Ltd.)

Instruments for the Measurement of High Vacua—The Vacustat. (Mes. la.) Pp. 2. (London: W. Edwards and Co. (London), Ltd.)

A Catalogue of Books: Alchemy, Astrology, Chemistry and Allied Subjects; Botany; Early Medicine and Surgery; Addenda. (No. 584.) Pp. 40. (London: Bernard Quaritch, Ltd.)

Calendar for 1941. (Newcastle-upon-Tyne: C. A. Parsons and Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 4, No. 27. Pp. 23–34+iv. (Watford: Wild-Barfield Electric Furnaces, Ltd.)

Conti-Glo Fluorescent Decoration. Pp. 4. (Cleveland, Ohio: Continental Lithograph Corporation.)

The Use of Crystalline Vitamin B_1 Thiamin Chloride (Thiamine Hydrochloride U.S.P. XI) in Foods. Pp. 8. (Rahway, N. J.: Merck and Company, Inc.)

Kodak X-ray Direct Reading Localizer. Pp. 4. Kodak X-ray Materials and Accessories. Pp. 16. (London: Kodak, Ltd.)

Catalogue of Books relating to Egypt Ancient and Modern, including Egyptian Sudan. (No. 12.) Pp. 38. (London: George Salby.)